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Making an Optical Flat

The Kind of Glass and How It Is Cut Up—Grinding and Polishing—Testing Surfaces for Flatness

By RUSSELL W. PORTER, M.S.
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OPTICALLY flat disks of glass are coming into more general use in the machine shop for the purpose of checking up the wear on gage blocks, comparing standards, testing flat surfaces such as micrometer anvils, gaging the diameter of steel balls,

FIG. 1. HOW SMALL GLASS FLATS ARE BLOCKED UP AND POLISHED AS ONE LARGE DISK

etc. These glass flats should have surfaces more perfect than the work they are designed to check, and should be flat to a small fraction of a wave length of light (about 1/50,000 in.). The use of these flats was fully described in the *American Machinist* of Sept. 30 and Oct. 7, 1920. It is the purpose of this article to describe how glass flats are made.

The working of glass is entirely different from that of steel. Throughout the processes of grinding, polishing and "figuring," great care has to be taken as to optical cleanliness, temperature, and pressure. The methods are simple but laborious. Much patience is needed. The tests for flat surfaces are extremely sensitive and delicate; departures from a true plane of considerably less than a millionth of an inch can be detected. It is probably true that the number of opticians in this country capable of producing large optical planes, flat to a millionth of an inch, may be counted on the fingers of one hand. This country sorely needed such men during the war, when thousands of planes and plane parallels were required by the army and navy for telescopic sights, periscopes, range finders, sextants, etc.

Pure optical glass is not required for glass flats. As refraction and dispersion do not function in their use, some non-homogeneity and strain are allowable. Commercial polished plate glass answers every purpose. The disks should have a thickness not less than one-fifth their diameters. They are cut from rectangular slabs of the plate by a thin tube of iron or brass held in the spindle of a sensitive drill press, water and abrasive being added as the cutter works slowly down through the slab, leaving a true circular disk. The glass is now ready for fine grinding.

The method from now on is a lapping process. The glass is ground as fine as possible with washed abrasives. As plate glass is already quite flat, only the finer grades of abrasive are required. The glass is then transferred to a bed of pitch checkered into squares by grooves, or covered with holes, to allow free access of water and rouge (peroxide of iron), and the surface brought to a complete polish. This requires about 10 hours. The disk may then be said to be one quarter finished; the remainder of the work is spent in making the surface *flat*, or in "figuring." During this period the glass is frequently tested by methods about to be described, and slowly brought to a true plane.

Knowing When Glass Is Flat

It may seem strange, but optical flats are much harder to produce (as well as more expensive) than curved surfaces such as lenses or telescopic mirrors. As Uncle John Brashear once remarked when asked if flats were hard to produce. "Oh no, it's nothing to make a glass flat; the trouble is in knowing *when* it's flat." He meant by this that the surface is continually changing from a convex to a concave surface of revolution, passing through the plane.

The machinery necessary for working the glass is exceedingly simple. The work is placed upon a vertical

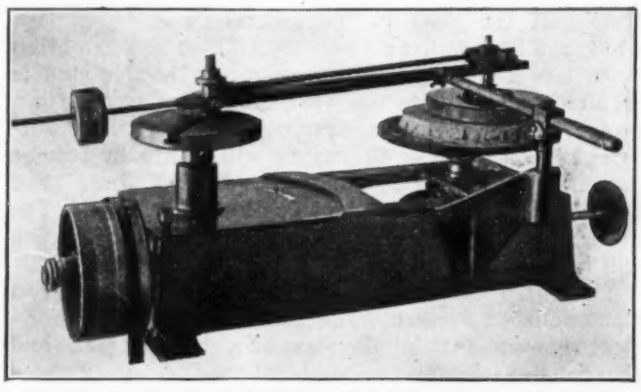


FIG. 2. A GLASS GRINDING AND POLISHING MACHINE

spindle and slowly revolved. The grinding tool or pitch lap is moved back and forth over the glass by means of a crank whose stroke or length of throw may be altered at will. The laps are not held rigidly to the crankarm, but by a loose joint and left free to conform to the surface of the glass. Some machines provide for a slow rotation of the lap in a direction opposite to that of the

work. For medium-size work there are somewhat less than sixty complete strokes per minute. For small work several disks are polished at once. They are set into a large glass disk, as shown in Fig. 1, in which holes slightly larger than the small flat have been bored.

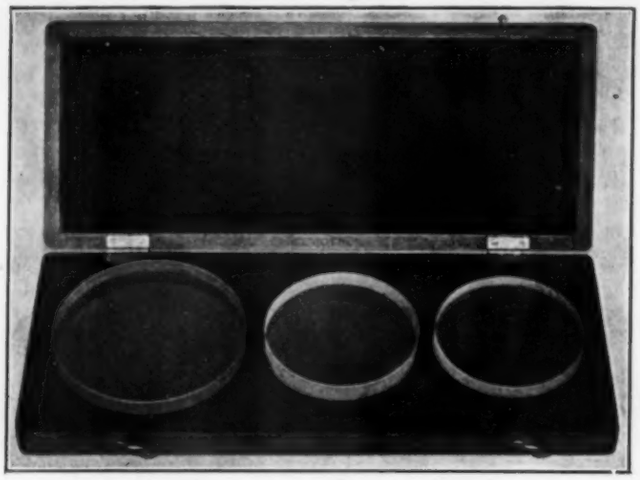


FIG. 3. A SET OF OPTICAL FLATS

They are bedded in plaster of paris and the work "figured" as one flat. This method prevents grinding down the edges of the small flats.

Nevertheless all the thought in machine design tending to produce optically perfect surfaces falls far short of the end. A machine will bring the glass to about 1/100,000 in. of the true surface, but the last "figuring" must be by manual labor. The writer has incorporated in the machine illustrated in Fig. 2 all the possible motions needed in working glass surfaces; straight, elliptical, circular strokes, strokes eccentric to the center of the work, variable length of stroke, and work and lap revolving in opposite directions. But the most effective work has been accomplished with the simple straight stroke, and altering the surface of the lap. And he is prone to admit that local correction is best done by hand.

Use Cast-Iron Laps

Before proceeding with the testing it may be well to state that the glass is fine ground on cast-iron laps which are kept as flat as possible. These laps are often much larger than the work, hence considerable skill is required to distribute the wear over them evenly from center to edge. Most mechanics know that three surfaces rubbed together alternately will eventually become flat, no matter what shape they had at first. For quantity production iron laps are to be preferred. The glass is thus made sufficiently flat, so that the pitch lap will take care of the remainder of the operations.

There are three independent methods of testing a plane polished surface. The simplest but by no means most rigorous, is to lay the glass on a standard plane and observe the interference bands where the two surfaces are in near contact. The shape of the bands is an indication of the character of the surface. If straight, the glass is flat; if curved, the glass is concave or convex, depending on whether the bands move in toward the center or out from it as the eye is lowered.

This method does very well for small work. Its weak point, however, lies in the fact that the assumed standard may *not* be flat at the time of comparison. A sudden change of a few degrees may spring it convex. If the work is cooler than the standard, then on contact the upper face of the standard will be cooler than the lower, and it will go concave. Three optical flats belonging to the Jones & Lamson Machine Co., Springfield, Vermont, are in a case shown in Fig. 3. They are from 4 to 5 in. in diameter. They stand the test of laying No. 1 on No. 2, No. 2 on No. 3, and No. 3 on No. 1, without showing departure of the fringes from straight lines of more than ¼ of a band or about 1/500,000 in. This method of applying three surfaces together is absolute, requiring no assumed standard for comparison.

Far more exact is the knife-edge test at the center of curvature of a concave spherical mirror.

By reference to the diagram, Fig. 4, an artificial star or point of light at *A* is made by perforating a tin chimney opposite the flame of an oil lamp. Being near the center of curvature of the mirror, all rays from this point will go out to the mirror as radii of the sphere and be reflected to a point at *B*. If now the eye is placed in the position indicated, the mirror will appear uniformly illuminated like a full moon. And if a sharp edged opaque object like a knife blade be moved slowly across the reflected rays where they cross at *B*, the mirror will darken uniformly and become black and, although concave, it will have the appearance of perfect flatness—manifestly an optical illusion. The point *B* is in fact an image of the pinhole on the lamp. It may be magnified and studied by means of an eyepiece.

Using the Knife-Edge Test

Now, if the glass to be tested is interposed between the mirror and the eye, as in Fig. 5, the mirror is seen by reflection in the glass flat. If the glass *is* flat, the mirror will have the appearance of flatness when the knife edge is moved across the point *B*, exactly as in Fig. 4. If it is concave or convex, a so-called "knife-edge shadow" will appear on the glass that will tell the experienced optician all he desires to know as to its surface.

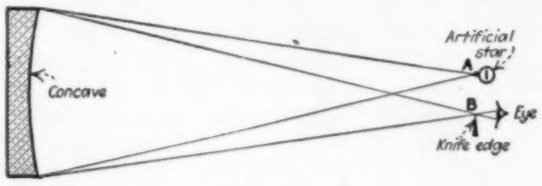


FIG. 4

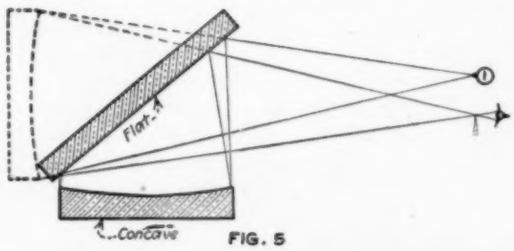


FIG. 5

FIG. 4. TESTING A CONCAVE SPHERICAL SURFACE BY MEANS OF KNIFE-EDGE SHADOWS. FIG. 5. TESTING A FLAT SURFACE BY THE SAME METHOD

He modifies his lap, length of stroke, pressure, hardness of the pitch—whatever change he estimates will improve the surface—and polishes a few moments. Another test. And so on. He finds himself forever near the illusive true plane but shifting from one surface of revolution to another. It may be spherical, paraboloidal, ellipsoidal,

or hyperboloidal. He must wait some time after each polishing for the glass to regain a uniform temperature, for the heat of friction has made it convex. The manner in which these curious knife-edge shadows are interpreted is beyond the scope of this article. Suffice it to say that errors of much less than a millionth of an inch show up glaringly.

The Water Test

A third and absolutely rigorous test for flatness is the Rayleigh or "water" test, so-called. The glass is immersed in a pan of water resting on a substantial foundation, with one or two millimeters of water covering the glass surface. The glass is leveled until parallel to the water surface when interference takes place between the water and water-glass surfaces and bands are seen traversing the glass, much as in the first method of testing described. Here our standard is the water surface. To be exact it partakes of the curvature of the earth, but this may be disregarded except for large work. The supports must be very rigid, with total absence of vibrations or air movement. The test is so sensitive, the conditions in fact must be so perfect, that unless for exceptional work the method is not to be recommended. I think it was Lord Rutherford who said the test was all right, but the earth had to be stopped from revolving while the experiment was being conducted.

The manufacture of plane parallels, where opposite faces of a block of glass must be not only flat but parallel—such as sextant mirrors, pentagon prisms of artillery range finders, plates of echelon interferometers—involves many ingenious processes, but must be deferred for another article.

Choosing Foremen and Executives from the Ranks

By John Mark May

That there can be no hard and fast rule that will apply at all times to the selection of candidates for foremen and executives is accepted quite generally. There seems to be in the minds of many who have such selections to make that there are peculiar conditions affecting their cases that are not common to other organizations.

Some think that the duties of workmen and their executive demand abilities differing to such an extent that it is questionable whether a workman, while performing his regular duties, can acquire the necessary knowledge to fit him for an executive position. Others think that a man who has worked in the ranks can never as successfully supervise those who have been his fellow-workmen as can one coming from outside and not so well-known, or perhaps unknown, to the men he is to supervise.

Still others think that no man can be a successful executive until he has had more or less actual executive experience; which means that when a man is raised from the ranks to an executive position he must be tolerated for some time at least, and in the meantime the business will suffer, also that it is preferable to secure a man from outside who has at least been through the probationary stage.

Then there are those who believe that it is for the best interests of all concerned to make promotions from the organization, and that make it a rule that is observed in all but very exceptional cases.

One of the burdens of the manufacturers, especially in recent times, has been the high cost of labor turnover, and there seems to be considerable uncertainty yet about permanent relief in this matter.

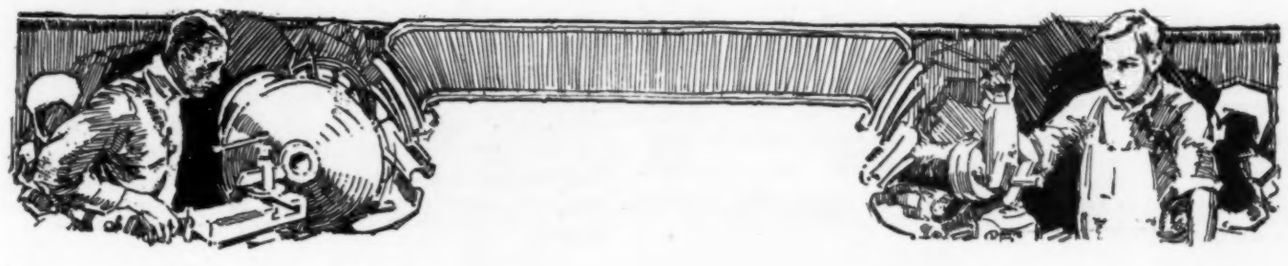
While wages and working conditions are the two greatest factors in keeping men contented, sentiment always has and always will be a factor worthy of consideration. Many men who are good citizens, intelligent and capable workmen, will remain with an organization, even when they could do better elsewhere, because of home ties, friendships, social privileges, property rights, and many other things that make up their surroundings. Some of these are favorable material for executive positions. Is it fair and is it profitable to withhold the opportunity from these men?

This is not the only class that constitutes favorable material; but this class is spoken of particularly because of the fact that they are among those who will not leave their present employers and therefore, would not, except in rare instances, receive promotions to executive positions.

Without exception the impression is given by employers that length of service counts for much, but if the executive positions are given mostly to someone outside the organization it is likely to foster a feeling of discontent that tends to break down the morale of the organization and cost the employer more than it would to bear the expense of educating favorable prospects.

I would rather speak of the early days of the new executive as educational days than as referred to at first as a time during which he was tolerated; believing it to be more nearly correct. All men have to be educated and it would seem that every organization should take a part in it. It looks like a confession on the part of those who are unwilling to shoulder this burden that they are unable or unwilling to make conditions such that men can develop the best that is in them; and surely the places where such conditions do not obtain are not the places that the best men can be expected to seek.

Not only when other things are equal do I believe the present employee should be given a chance at executive work, but even when the odds are somewhat against him. For the reason given above I believe he should have first consideration and that when all factors are worked out to a logical conclusion the plan would be to the best interests of both the employer and the employee.



The Economics of Production

II. CHANGES IN DEMAND

By Prof. D. A. McCabe, Ph. D.

IN THE first article we discussed the nature of demand and the items by which we measure its strength or weakness at any given time. We turn now to changes in demand, to increases and decreases from one time to another in the willingness to buy. Just as we measure the strength of the demand at any one time in terms of both price and quantity, so we shall see that changes in demand are expressed and gaged in the same terms—price and quantity.

A change in the demand means a change in the demand schedule—a change in those quantities demanded that corresponds with certain prices which might be charged. It means first, of all, for practical purposes, *a change in the amount demanded at the old price.* If, for example, 100,000 wrenches of a certain type were sold last year at $1, and the number that could be sold at that price this year is greater or less, there has been a change in the demand. If less than 100,000 can now be sold at $1, there has been a decrease in the demand since last year. If more than 100,000 would be taken at the old price, the demand has increased.

A change in the price that can be got for the old quantity is also present in practically every change in demand. When the amount demanded at the old price changes, the price that can be obtained for the old quantity also changes, almost as a matter of course. If only 96,000 of the wrenches can now be sold at the old price of $1, how much will 100,000 wrenches sell for? Obviously they will command less than $1. On the other hand, if the public asks for 107,000 wrenches at $1, it can be expected that if only 100,000 wrenches are offered, the public is willing to pay more than $1.

Thus, *an increase in demand means not only that the quantity demanded at the old price has increased but that the price that can be obtained for the old quantity has increased. A decrease in demand means both that the quantity demanded at the old price has decreased and that the price that the old quantity can command has decreased.* The old correspondence between certain prices and certain quantities has been broken. New quantities demanded now correspond with the old schedule of suggested prices and new prices are now paired off with old quantities, as the table illustrates:

Suggested Price	Old Quantities Demanded	Increased Demand	Decreased Demand
$1.05	96,000	100,000	90,000
1.00	100,000	107,000	96,000
.95	107,000	105,000	100,000

These figures are of course made up simply for purposes of illustration.

An increase in demand means not only that the quantity demanded at the old price has increased, but that the price that can be obtained for the old quantity has increased. A decrease in demand means both that the quantity demanded at the old price has decreased, and that the price that the old quantity can command has decreased. The old correspondence between certain prices and certain quantities has been broken. New quantities demanded now correspond with the old schedule of suggested prices and new prices are now paired off with old quantities.

How do such changes in demand affect production? They affect it by indicating to the producers that an increase or decrease in the production of that particular commodity is wanted. If a larger number of units, say 107,000, can now be sold at the old price of $1 than could be sold before at that price, obviously there is the same incentive now to produce 107,000 that there was before to produce 100,000. But more than that, if a higher price than $1, say $1.05, is bid for the old quantity of 100,000, the producers are also led on by the lure of the increased profit on each wrench to produce more wrenches.

If, to take the opposite case, the amount demanded at $1 falls to 96,000, the incentive to produce more than 96,000 wrenches is gone. If 100,000 are produced they will have to be sold at 95 cents. Of course more than 96,000 may be produced, in the hope of a rise in price later, and to avoid loss in some other direction, but there is no greater incentive offered now to produce more than 96,000 than there was last year to produce more than 100,000. Thus the demand, using the price offered for the old quantity and the quantity demanded at the old price as its indicators, gives its instructions to the producers.

The "Equilibrium of Demand and Supply"

It is not urged here that changes in demand are the only things that change the volume of production. That may be changed also because of changes in costs. Costs of production affect the quantity produced very materially. The point is that the producers aim to produce that quantity that will give them a price which covers costs of production and a profit. What the price is that will cover costs depends upon the costs. What the *quantity* is that can be sold *at that price* is a matter of demand. The quantity has to be so adjusted that it will strike a price on the demand schedule that at least covers the costs of production. That is essentially what is meant by the expression "the equilibrium of demand and supply" in connection with production.

The place of demand and of changes in demand in the determination of what is to be produced and how much of it, has now been considered. Demand is not the only thing affecting production but it is an essential thing. The other things have to be adjusted to it. The relation of costs of production to price and so to the quantity produced has also been touched upon. In the next article cost of production and its bearing on price and the quantity produced will be considered at greater length.

Machining the Wrigley Automobile Transmission Gear

III. Machining Operations on the Gear Frame and Axle Parts—Assembling the Gear Frame—Methods of Checking Up the Different Parts

By I. WILLIAM CHUBB
Editor, European Edition, *American Machinist*

THE center case, Fig. 18, is a steel casting in which the first operation is to bore and ream the torque-tube hole: Bore, ream, and face for the gear-frame register and seating, and bore and face for the axle-case cover. Owing to the length of the

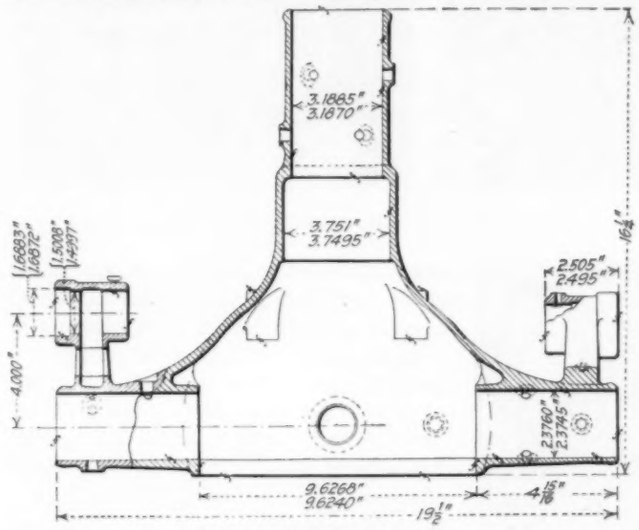


FIG. 18. CENTER CASE

operation, two machines are employed for this. The body is gripped in an ordinary chuck by the smaller end and a standard bar is put up at the open end, the tubular portion of the job entering the hollow spindle of the machine. The second operation is that of rough-boring, finish-boring, and reaming and facing one axle-sleeve hole (see Fig. 19). The job is located on the large register previously bored, and two machines are in fact employed, one each for the two axle-sleeve holes. The first hole bored is picked up by a plunger in order to line up for the second hole, the location for the first

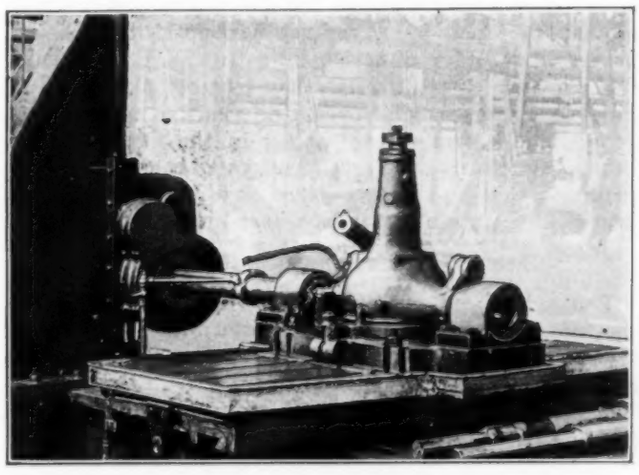


FIG. 19. BORING AXLE SLEEVE HOLES

bore being by a taper plug entered into the cored hole.

The fourth operation; Fig. 20, also in a horizontal boring machine, is to drill, bore and countersink each outrigger arm. As these are off center it is necessary to employ an eccentric fixture which throws the case out and thus brings the arms on the center line. Two machines are employed for right and left hand.

Next, under an Asquith radial, two tapping holes are drilled in the outrigger arms, and the center-case arm bushes are fitted and spun over. No special fixture is employed, the phosphor-bronze bushes being driven in with a register bung and spinning tool with revolving rollers employed to rivet the metal over. Up to this point nothing has been done with the end of the torque-tube hole. A facing head is used with a running bush to prevent scoring, and the job, clamped to the table of the machine, is cleaned up to length. Then, under another Asquith radial drill, the four gear-frame bolt holes are drilled and reamed. A plug takes the larger bore and the drill jig, Fig. 21, is located off the top bore, the jig dropping on seatings and being located sideways by a plug which fits a square slot, the plug being placed through the axle-sleeve arms.

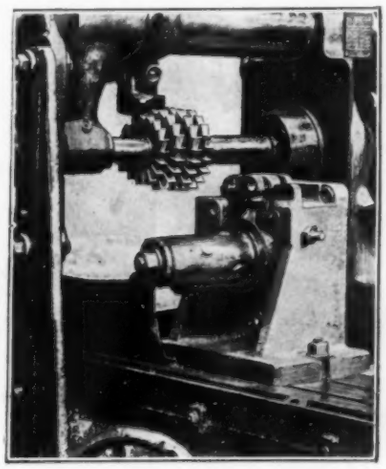
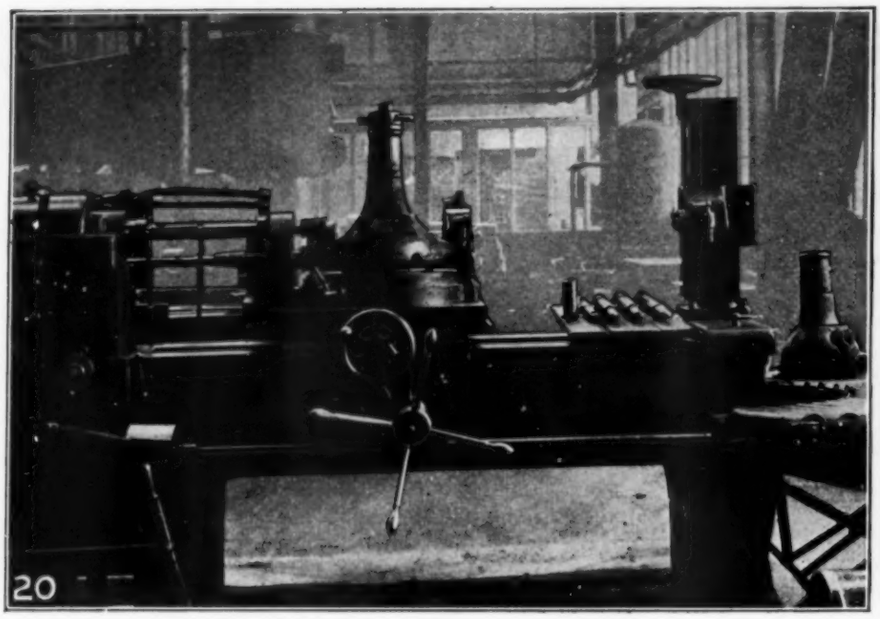


FIG. 25. GANG MILLING FULCRUM PIN BOSSES

The final operation, also under an Asquith radial, is to bore, face and tap the drain hole, drill, face and tap the breather hole, and face the back of the gear-frame bolt bosses. The job is put on an angle plate and located off the large bore. For the breather hole the job turns on a spigot, and for the spot-facing process the case is dropped on the table and the facing bar brought down, with a gage to check the height of the facing from the base.

The brake bracket, Fig. 22, is in two forms, for off and near sides respectively, both being steel castings. First, in a No. 9 Herbert lathe, the bracket is rough-bored, the 100-mm. ball-race diameter is bored, and the job is screwed for the hub bearing cap. It is gripped by the shank in a bell chuck (Fig. 23), with a cone-shape location at the inner end to take the small end of the job and three screws at the front to nip the bosses. The diameters are worked off the turret of the lathe and the facing off the square post on the cross-slide.

In the second operation the case is finish-bored and



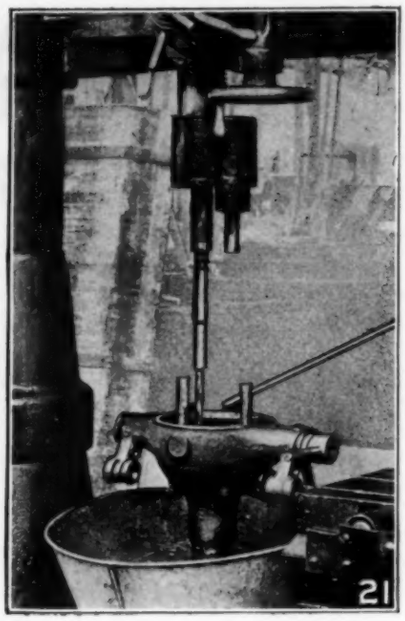


FIG. 20. BORING OUT TRIGGER ARMS (SHOWING ROLLER CONVEYOR). FIG. 21. DRILL FOR GEAR FRAME BOLTS

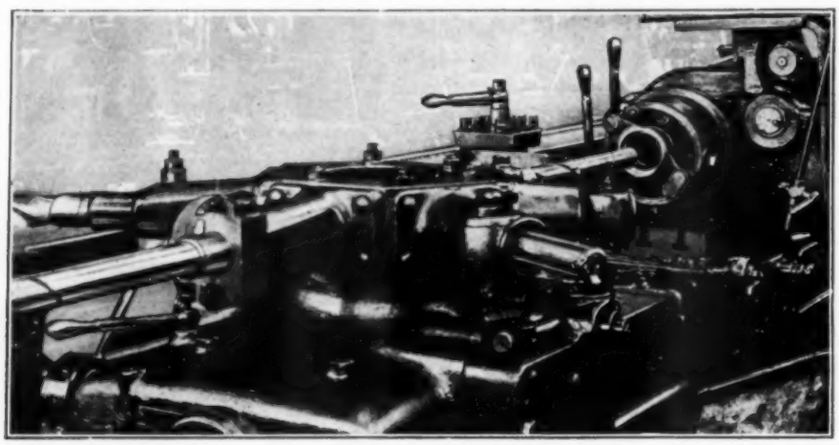


FIG. 23. BORING AND SCREWING BRAKE BRACKET IN BELL CHUCK

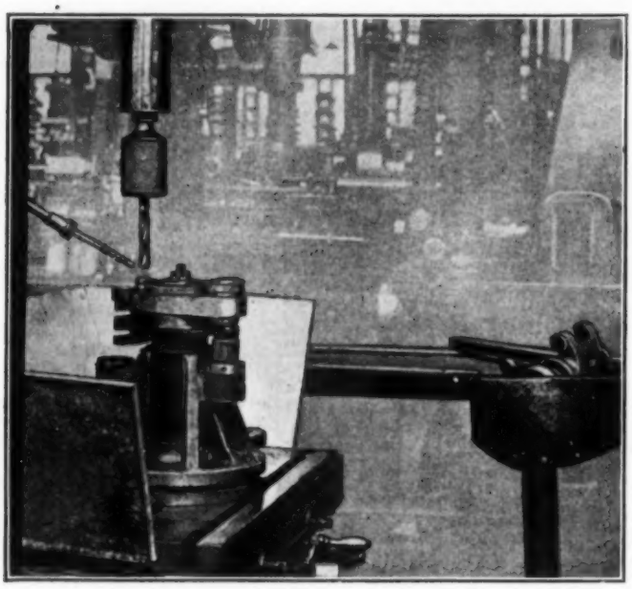


FIG. 24. DRILLING CAM AND FULCRUM HOLES IN BRAKE BRACKET (ALSO SHOWING CONVEYOR POCKET AND BAFFLE)

reamed, faced to length and the dust-cover register turned. The 100-mm. bore is used to locate on a plug on a circular plate with special straps to grip the job. The job, being a steel casting, carries a certain amount of sand, so that, as before, the boring bar has a deep helical groove in order that the sand, together with the chips, etc., may be removed with a heavy flow of oil. Next, under a drilling machine (Fig. 24), the 1¼-in. cam hole is drilled and reamed and the fulcrum pin holes are drilled. A swiveling indexing fixture is used, eccentric because the center distances of holes are not the same. The job is located on a seating with a central plug and the top jig plate registers in the 100-mm. ball race, the position of the holes sideways being obtained by contour.

Three sub-operations form the fourth operation, all done on horizontal milling machines. In the first (see Fig. 25), for milling fulcrum-pin bosses, the job is threaded on a plug through the sleeve hole and brought against the face by a central horizontal bolt, being located in a rotary direction by a peg in the cam hole. The pressure of milling is taken by a crank lever. A gang of cutters is employed, the position of the cutters being determined by a peg in the fixture which locates the central cutters. The gang consists of two ordinary side and face cutters and two interlocking cutters to maintain distances where brake shoes fit.

Milling for the Spring Shackles

The second sub-operation is milling for the spring shackles. A central horizontal locating stud is used, turned away in several places to correspond with the positions of the cutters, thus forming a setting device. The brackets are right or left hand, according to the position of the shackle boss. A movable locating stud is placed at the top of the fixture and is wound over to the two positions according to the position of the

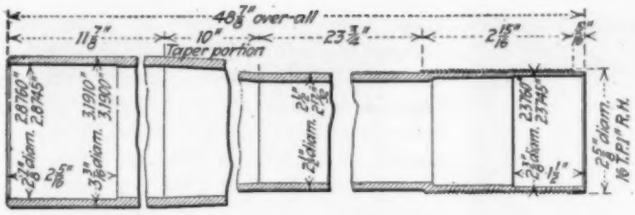


FIG. 26. TORQUE TUBE

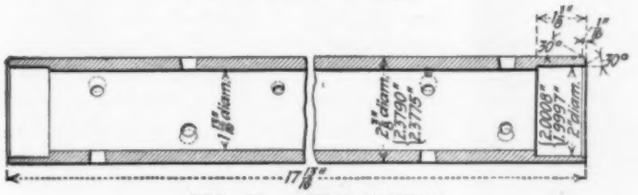


FIG. 27. AXLE SLEEVE

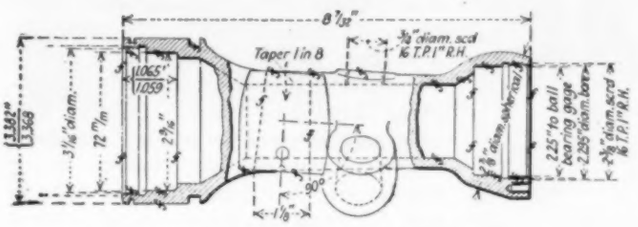


FIG. 30. STUB AXLE SLEEVE

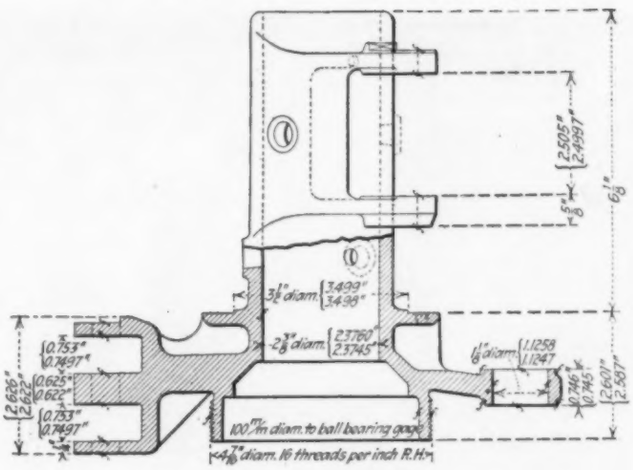


FIG. 22. BRAKE BRACKET

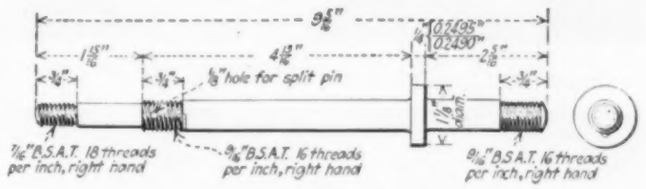


FIG. 37. GEAR FRAME BOLT

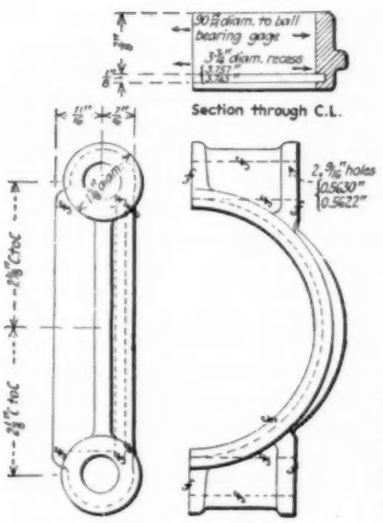

90.75° diam. to ball bearing gage
3 1/4" diam. recess
3.327" 3.323"
Section through C.L.
1 1/8" diam.
2 9/16" holes 0.5630" 0.5622"
1 3/8" C to C
2 1/2" C to C

FIG. 34. PLAIN BORE GEAR FRAME CAP

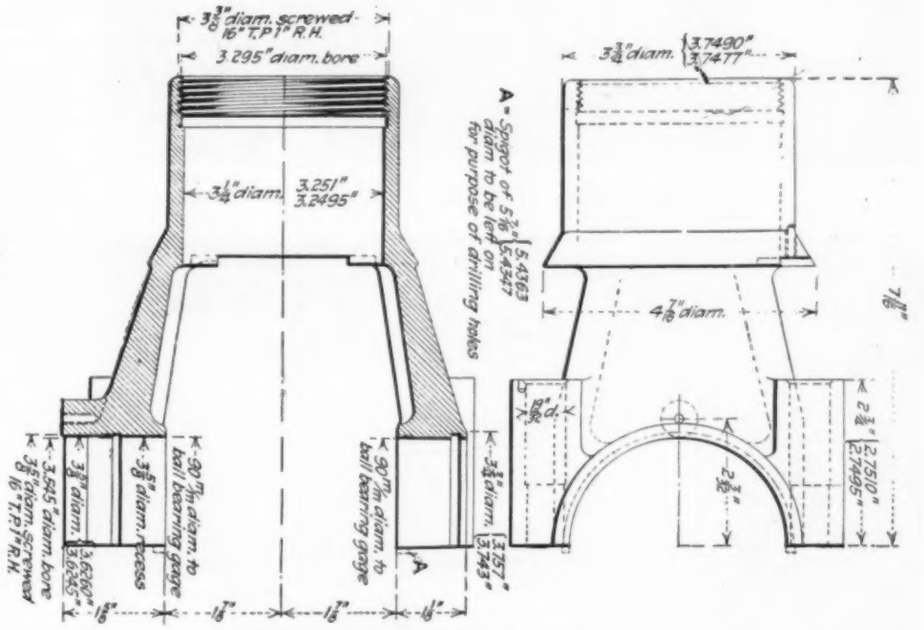

3 3/8" diam. screwed 16 T.P.I. R.H.
3.295" diam. bore
3 1/4" diam. 3.251" 3.2495"
3 3/8" diam. screwed 16 T.P.I. R.H.
3.345" diam. bore
3 3/4" diam. 3.6086" 3.6065"
3 5/8" diam. recess
90.75° diam. to ball bearing gage
90.75° diam. to ball bearing gage
3 3/4" diam. 3.757" 3.743"
A
A - Spigot of 5 7/16" diam to be left on for purpose of drilling holes 5.4363" 5.4347"
3 3/4" diam. 3.7490" 3.7477"
4 7/8" diam.
1/2" rad.
2 3/4" 2.7510" 2.7495"
2 3/4"
7/8"

FIG. 32. GEAR FRAME

shackle boss. The fixture has an outer support for taking the pressure of the cut. Then, for milling the cam lug, the job is placed on a horizontal plug, located according to the casting, with a cutter-setting gage on the fixture. A pillar drill is used for the next operation, namely, drilling and reaming the spring-shackle pin holes, drilling a ½-in. clearance hole through the shackle lugs, and facing the cam hole. In the jig the job is dropped on its face and held by a vertical central bolt, being located for either hand by a plug at each side. In order to drill the ½-in. hole a drill jig registers in the hole just produced. The facing is really a bossing operation, with an ordinary bar and cutter. The final operation is done in a two-spindle drill. The jig locates on the dust-cover register and has to be cut away to clear the arms on the casting. The holes are drilled as far as possible, then the jig is turned round, the plug put in second position and the remaining holes are drilled.

Machining the Torque Tube and Assembly Brackets

The torque tube, Fig. 26, is threaded in an ordinary lathe and runs on large ball bearing cone centers. It is then ground to fit its housing, becoming subsequently a sub-assembly. The axle sleeves, Fig. 27, are part-bored and turned at the ends in a center lathe and then taken to a Norton machine for grinding on the diameter, a cone mandrel in the bore driving. Then

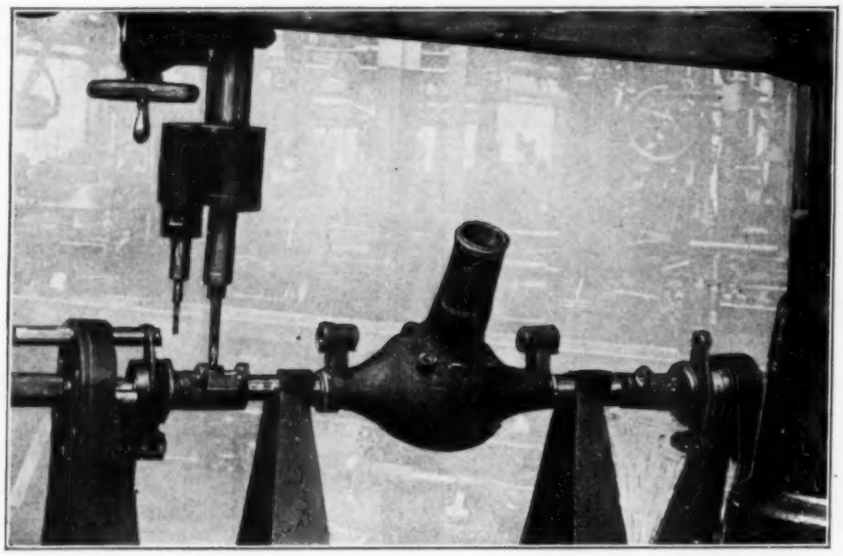


FIG. 28. DRILLING BRAKE BRACKET AND CENTER CASE

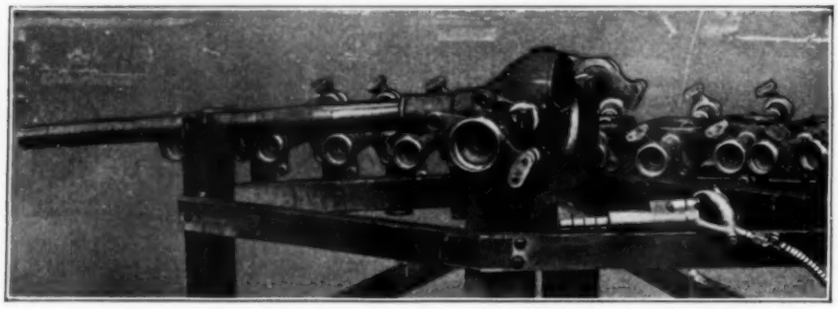


FIG. 29. CRADLE HOLDING SUB-ASSEMBLY FOR RIVETING

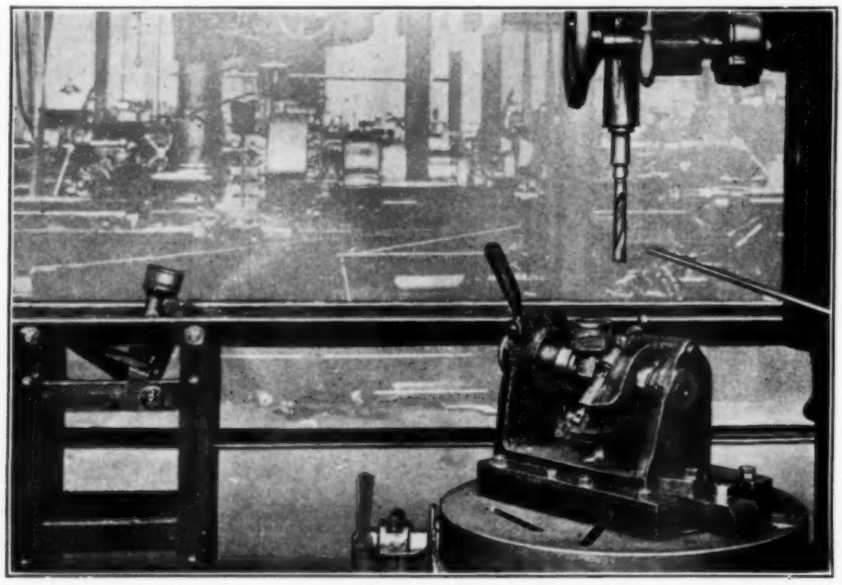


FIG. 31. DRILLING AND REAMING TAPER HOLES FOR SWIVEL PIN

in a hydraulic press the right- and left-hand brake brackets are forced on the sleeves and the sleeves in turn pressed home into the center case. The job is then mounted in a cradle (see Fig. 28) and a number of rivet holes are drilled, the brackets, etc., being finally pinned in place, and two holes drilled and tapped in the outrigger brackets for lubricators The job then goes to the press to have the torque tube forced in, then taken to the radial drill under which the torque tube is dropped on V-blocks in order that rivet holes may be drilled, when it passes to the cradle (Fig. 29) and all rivets are driven in with a pneumatic hammer to complete the back axle.

The stub-axle sleeve (Fig. 30) is in two slightly different forms, that is, right- and left-handed. For the first operation, rough-boring and rough-turning the large end, the job is held in a shaped three-jaw Coventry chuck and set by a running center in the capstan of a Herbert lathe, a twist drill being sent up for the bore, and the end rough-turned by a tool on the cross-slide. It is then held in the fixture in a Warner & Swasey lathe and finish-turned and ringed on the outer diameter, bored and reamed for the ball race and screwed internally, standard reamers and circular chasers being employed. The rings turned outside are for holding oil-retaining wipers for providing an oil seal. Then, gripped in a three-jaw chuck having soft jaws turned to size, the job is bored and screwed at the small end complete on another Warner & Swasey machine, and taken to a horizontal miller for facing the boss of the large taper hole, a piece having been left on owing to the fact that the job is a stamping. The job is held on a horizontal arbor between centers in brushes while the metal is removed. Then in an upright drill the large taper hole is drilled, reamed and the end faced. It is located off the large and small ball-race diameters in a fixture (Fig. 31) which is set off 3 deg. in order that the front wheels may have the required rake for the road. In a similar fixture, locating by the large and small diameters, the job is pulled round to a stop in order to drill, ream, face and tap a small taper hole for the steering arm. Then, using a standard angle plate, a $\frac{3}{4}$-in. hole is drilled and tapped for lubricating purposes in the top of the sleeve, the position of the hole being set by eye to the stamping. Finally a series of small holes is drilled to allow the oil to get through to the steering arms, this being part of the self-oiling system, and the outer hole being subsequently plugged. The job is held by the taper hole from a central stud with a drilling plate over the top located by stops for the two hands. Similar jigs are used for drilling the holes in large and small bosses. A peg hole is drilled in the end of the small boss, by contour. The details are then taken to a bench where they pass through the usual manual operations, such as burring, that are necessary to make a smooth job.

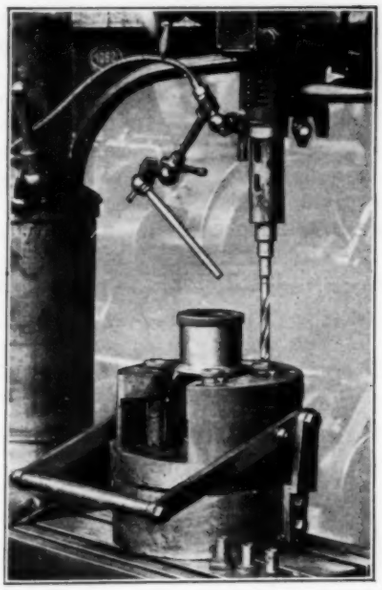


FIG. 33. DRILLING BOLT HOLES IN GEAR FRAME

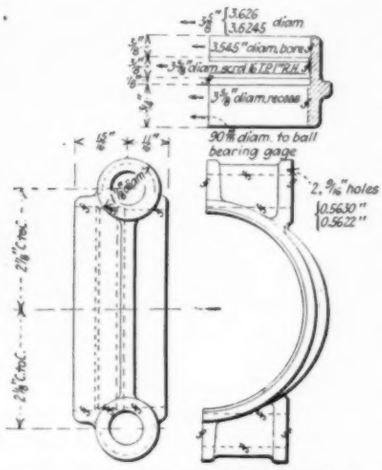


FIG. 35. THRUST GEAR FRAME CAP

The gear frame, Fig. 32, is a steel casting. Held on the diameter, the stamping is taken to a Gisholt lathe and the hole is roughed out by a drill and the end faced, leaving a small spigot (locating pin) which is afterward removed. The backs of the lugs are also faced. No special equipment is employed here. In another Gisholt lathe the job is bolted by straps to a locating plate turned to suit the spigot and itself bolted to the faceplate. The location plate contains a pilot bush for finish-boring and reaming the large hole. Before this, by means of a central bolt passing through the spindle of the lathe, the outside of the main boss is roughed. A Herbert lathe is then used in much the same way for finishing the piece internally and finish-turning the diameter and chamfering and radiusing the end, a combination gage being employed to insure concentricity between bore and screw thread. Next in the horizontal miller the seating is faced inside the main boss for the locating plate for the housing for the bevel pinion; and similarly for bevel-wheel clearance, side and face cutters being used and the job being registered by the four projecting bosses on an angle plate.

For the next operation a special turnover jig, illustrated in Fig. 33, is used for drilling the four holes for the gear-frame bolts. These hold the caps in the gear frame and the gear frame to the center case. The piece is registered again by the four projections with the addition of a central plug. The job is drilled from each side so that the jib has to turn over, and finally the frame is reamed from one side only. The four register points being filed off, the gear frame passes to a sensitive drill which drills holes for snugs, etc., and for locking-plate hole at the side. In this fixture the gear frame is dropped on a central bolt, the jig plate locating in one of the four holes for the locking plate, and a plate ring located on the two $\frac{9}{16}$-in. holes, with four bushes, is for drilling snug holes for the gear-frame bolts, to prevent them turning round.

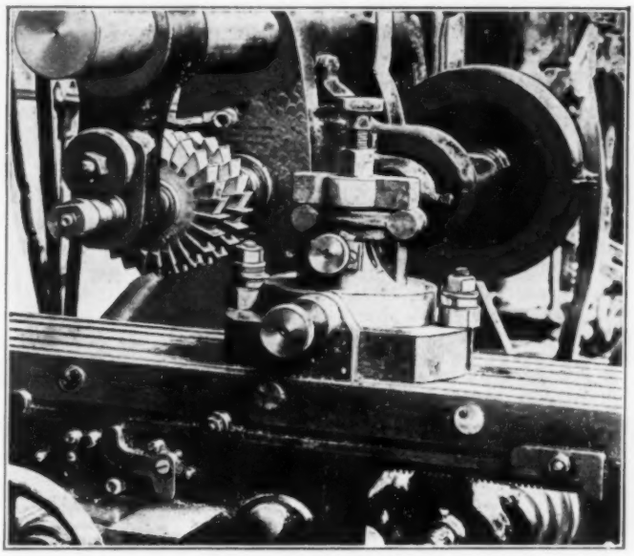


FIG. 36. MILLING TWO CAPS IN INDEXING FIXTURE

The gear-frame caps, Fig. 34 and 35, are steel castings. First placed under a horizontal miller, the piece is put into an indexing fixture, Fig. 36, which locates inside the contour and is secured by the outside contour. The whole is held down by a central bolt and strap and sideways by a spring-operated clamp. A cut is taken across the bosses at one side by a pair of straddle mills, and then the job is indexed round for the other side, to provide cap seatings and nut seatings. Two bolt holes are next drilled under a radial drill and the piece then goes to sub-assembly.

The gear-frame bolt, Fig. 37, is an ordinary turning job done in the Jones & Lamson lathe; passing to a Herbert capstan lathe the bolts are secured in a three-jaw self-centering drawback collet and threaded with a standard Coventry dieholder, subsequently being drilled for snug (dowel-pin) hole and for a split cotter hole, the snug being afterward fitted.

Assembling the Gear Frame

The parts of the gear frame, having been assembled and the burrs removed, are finally bolted together. The gear-frame bolts have to couple up four pieces, namely, the gear frame, the gear-frame caps, the center case and the center-case cover. No clearance is allowed in the holes; consequently all the jigs and testing fixtures must be accurate. One testing fixture checks the holes in the gear frame for center distances and concentricity of body. It takes the form of a central housing to locate the body and four studs on which to drop the gear frame. The fixture can also be used

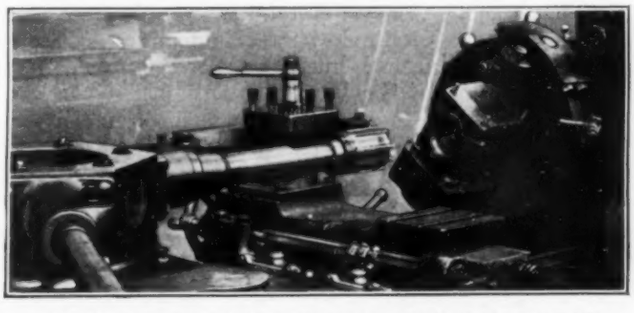


FIG. 38. BORING AND SCREWING GEAR FRAME FOR DIFFERENTIAL HOUSING

for checking the caps for center distances. Another fixture corresponding to the center case has four bushes into which the job can be dropped by the four bolts, thus testing their centers and concentricity again.

After sub-assembling, the piece is put into a fixture, Fig. 38, which has a housing containing on one side four locating bushes which line up the bores for the differential housing and the bearings for the bevel gear. The heads of the bushes also give correct center height to insure the job coming down to the shoulders of the gear-frame bolts. A cap plate screws into the internal thread cut on the bevel pinion housing end to draw the job down to the seating. Also at the top a plate forms a strap over the ends of the bolts and a central pressure screw keeps the job rigid while the holes are being bored and screwed. The fixture is also used as a jig and is balanced to insure round holes. Rough- and finish-boring bars and sizing reamers for the bearing journal are employed, all in the turret of the Herbert lathe, the cross-slide carrying a recessing tool for clearance and a circular chaser for threading. The part then goes to the finished stores for assembly.

Organization and Management of the Small Shop

IV—Financing the Company—Co-operating With the Investor—Necessity of Proper Organization — Advantages and Disadvantages of Partnerships and Corporations

By E. W. LEACH

I AM sorry it is not possible for you to know me personally so that you could not fail to appreciate the sincerity with which I advise you to exercise every possible caution and discretion in seeking the capital for your business.

I do not wish to arouse in you a suspicion of the integrity of men with money. But capital is a peculiar commodity, earned only through hard work and parted with only under pressure or under promise of multiplication through investment. It possesses real potential energy, the power to do things; but it is possible of strange manipulations, and can easily be the basis of misunderstandings which can seriously interfere with the progress of a business organization. You have a product for which you know there is a market. Don't say to yourself, "Now if I can only get hold of so much money I'll be taken care of in nice shape," and then blindly accept the first offer of that sum without proper consideration of the individual who offers it and the terms on which it can be obtained.

In a tractor or an auto truck we sacrifice speed to obtain power; in a racing car it's just the opposite case. You can't have a maximum of both characteristics. The moment you go out to seek capital for the development of your business you must sacrifice a part of something, and that something is your ownership of your own product and its future. There is only one reason why men will invest money in a business venture, and that is because they see the possibility of making more money. If you could equip your shop and market your product without outside assistance you would receive all of the profits which might accumulate. But "one-man businesses" are rapidly becoming extinct. The desirability of going ahead on such a basis is something you can easily determine yourself. We'll assume that you have *some* money. Establishing a business and putting it on a profitable operating basis is at best a real job for a real man, and it usually requires at least twice the length of time that was anticipated.

If you attempt to finance your business alone your investment will be small, your production will be small, your sales will be small, and your profits will be small. And besides, it is not likely that you have ability to supervise all the phases of the management of your business. If you have conceived and developed your product you are an inventor, you are mechanically inclined. It is probable you have been in that atmosphere throughout your whole business experience. It is not to be expected, therefore, that your ability to design machines will be no greater than your ability to plan sales campaigns or evolve methods for financing the business. I am working, of course, on the theory that no one knows it all.

This is an age of specialists. If you are proficient in inventing and designing you will find sufficient opportunity for unlimited individual accomplishment in developing your line of goods and managing their production. It will be much better that someone else assume the responsibility of the financial control of the business so that your mind can be more free for the problems with which you are especially fitted to deal. If you could invest a thousand dollars of your savings in starting your business, think what more you could do and what better results you could obtain if you had ten thousand dollars. You would then be able to have better equipment and hire more men. You could run the work through in larger quantities and cut down on your costs. You could advertise your goods more pretentiously and with printed matter that would really tipify the quality of your product. All of those things would be conducive to quicker returns, and that's what you are after.

But if you ask someone else to invest ten thousand dollars in your business you will have to sacrifice a part of the profits when they are realized. So the question you must ask yourself will be such a one as this: "If I try to make a go of this by myself it will probably be a few years before I am making any money. I can get outside parties to invest ten thousand dollars. That will give us a bigger start and get us on our feet sooner. And even though I must divide the profits which we will make, isn't it likely that I will be better off in actual progress and in dollars and cents by following the course which seems to promise most in the development of my idea?"

Seeking Outside Capital

In seeking outside capital there is one viewpoint from which there are two possible ways in which you and your prospective associates can arrive at the basis on which your company will be formed. One way is for you to arrange a plan of organization, carry it into reality, and then invite individuals to buy an interest in your company as already formed. That method, I believe, has too much of the "take it or leave it" appearance.

Unless you are more fortunate than the average individual you will not be able to find men who will be satisfied with every detail of your suggested plan. And if you have gone so far with your own personal ideas that the plan has no flexibility and does not permit remolding you may find it extremely difficult to raise the money you desire.

I have in mind a friend who wished to organize a factory for a certain kind of work. He figured he should have $20,000 in cash to carry out his plans. He and two friends incorporated for $50,000, issued $30,000 worth of stock certificates to themselves, and then went into the open market to find persons who would subscribe to the remaining $20,000 in stock. It proved to be one of those frequent things which just naturally "can't be done." The thought back of their plan was, of course, that in that way they would surely retain control of the company. That is all very desirable, but I do not believe any man or any group of men in this broad land of ours would ever put $20,000 into a business and receive 40 per cent of the stock against which 60 per cent of the stock had been issued to other parties and the books debited with such indefinite items as services, etc.

In this particular case it was impossible to sell any appreciable amount of the balance of the stock, and the incorporators had simply expended a lot of money foolishly and to no purpose. The second and much wiser way is to go to your prospective investor with a suggestive plan which can be revised in detail or in general substance until it is acceptable to all concerned. And of course this leads us to a consideration of the types of organization which you can use. Almost any textbook on organization has a chapter or two on the advantages and disadvantages of partnerships and corporations, so I shall only devote a few paragraphs to a very brief and informal discussion of the difference between those two forms, trying to bring out that difference without using the usual, stereotyped methods.

The Partnership Plan

A partnership is composed of two or more persons, any one of whom can be held liable for all the obligations of the company. I am not offering that as a definition of the term, but as an explanation of one important point that an investor will consider when putting money into such a business—his liability.

You, too, must consider that point seriously. To illustrate, supposing you get ten thousand dollars and enter into a partnership agreement. The business prospers and grows, and with the increased volume of production it becomes correspondingly necessary that your accounts payable increase until they may be several times the amount of the capital originally invested in the company.

If, some beautiful summer day, your partner should suddenly conceive the idea of drawing all the money out of the bank and sailing for the South Sea Isles, or if he should die, or if your plant should be destroyed by fire and your partner should not have cash to cover the loss—in any of those events you could be held personally responsible for full payment of all the obligations of the company. Any bills which had been contracted or any notes which had been signed as by the company (either with or without your knowledge) would fall to you for payment. Your home or any property which you might own personally could be taken to satisfy the claims against the company. And your partners, of course, must consider the possibility of finding themselves in the same predicament through any wrong action on your part or through causes beyond the control of anyone.

That, I believe, is the most important fact to prevent you from raising any material sum of money with such a plan of organization in view. Then, too, a partnership does not permit readily any expansion, for it is not so easy to raise more money which may later be necessary. A corporation can borrow money at the bank as an obligation of the corporation; but if you have not contributed to the original cash investment in your partnership and you suggest borrowing at the bank, your partners will not be apt to enthuse over that plan, for such a loan would bind each one of them individually and would be in substance the same as their own personal obligation.

Forming a Corporation

If your product shows possibility of forming the basis of a steadily growing business, it will be well worth your while to plan to incorporate. A friend of mine who lives in a small country town is interested in a business which originated as a partnership and was later incorporated. He told the cashier in his local bank that they planned to go through that procedure, and the banker replied, "Well, that may be all right, but it means an awful lot of red tape, doesn't it?" One would think that even a small town banker would have a more intimate knowledge of corporate organization, but his reply is typical of a great many persons who have never gone through the experience.

There is no special "red tape" about the process of incorporating a business that should scare you out of investigating the probability of that being the most desirable course.

Whether you wish to interest some one person who can also devote his entire time to the business, or whether you merely plan to raise money from any number of persons who will put up the money as a pure investment, there is a permanency and a definiteness about incorporation which cannot help but react favorably to your advantage when you express to those persons your willingness or your intention to use that as your form of organization. To incorporate you draw up a charter, or "articles of incorporation" as it is sometimes called, and submit it to the Secretary of State in that state under whose laws you are incorporating. When your charter has been O.K.'d or "granted" by that officer you hold the first meeting of the stockholders, at which the stock is subscribed and issued and the officers and directors of the corporation for the first year are elected.

State Laws and Corporations

Different states have widely varying laws in regard to corporations, so that in some states it is much easier to incorporate than in others. By, that I mean that certain provisions could be included in your charter under one set of laws which would be entirely impossible according to the laws of some other state. Any Secretary of State will send you a pamphlet of the laws of his state governing corporations, and this booklet will probably contain useful suggestions about incorporating. One thing you should learn is whether your state imposes a tax on "foreign corporations," that is, a tax on corporations operating in that state whose charters were granted by another state. If there is

such a tax in your state it may offset any slight advantage you might gain by filing your charter in a foreign state.

Then, too, there is a very significant disadvantage in selecting the "easiest state" in which to incorporate. If you do that your prospective investors may say to themselves, "Well, there must be something shady about that fellow's proposition; probably he couldn't get by our own laws." I know that if I lived in New Jersey and were asked to invest money in an Arizona corporation whose main office and factory were located right in Camden I should want to study the laws of those two states and learn the real reason for such an action before I parted with any very large sum of money.

But there is always an opposite extreme, and in this case rather than find the easiest set of laws and take out your charter under them it may be to your advantage to prove the soundness of your proposition by finding the most *stringent* set of laws and incorporating in that state where it is known to be extremely difficult for any but an unquestionably legitimate business to be approved.

I happen to be so fortunate as to number among my friends a gentleman who is president of an oil company capitalized at $50,000,000. In order to overcome the usual skepticism of "oil schemes" he organized under the laws of the State of Illinois, where I understand they are particularly conservative in the provisions of their charters. In his case, however, the number of stockholders was very large, whereas in small shops (and that's what you and I are interested in) that is seldom intended. If you have any sentimentality in your make-up you will want your charter obtained in your own home state unless there is a very decided advantage in going elsewhere.

Selecting Your Associates

You will not merely be interested in getting a certain amount of money; you will want to obtain that money from one or at least a very few individuals, and so you will be interested not only in their checkbooks, but in their character, their reputation, their business experience; in fact, in what more than mere money they can contribute to the prestige and progress of your business. It will be money well spent for you to employ an attorney to assist you in the details of incorporating. Not one of these attorneys who advertises "I will incorporate your business, give you a minute book, a seal, and a book of steel engraved certificates all for one hundred dollars." Go to a reputable firm who will give individual attention to your individual problems. The amount of stock, whether it will be all common or part common and part preferred, what per cent dividends the preferred stock shall carry, and a hundred other details are matters on which your attorneys will advise you. In deciding on the amount of capitalization you will want to consider how much capital you plan to raise at the outset, what probable future expansion there will be to finance, and what size you can reasonably expect your business eventually to assume.

In providing for both common and preferred stock you must understand the differences between the two kinds. Only holders of common stock vote at the stockholders' meetings and have a voice in the management of the company. Preferred stock invariably carries a definite dividend, such as 7 or 8 per cent. That dividend is guaranteed. If it is not declared one year because there has been no profit made most charters provide that it be made up the next year. If the company has made a profit, holders of preferred stock must be paid first. If any of the profit remains after this has been done, all of that profit is paid out as a dividend on the common stock. I do know of one local company whose preferred stock guarantees 8 per cent and then shares equally with the common stock after the common has received 8 per cent. This makes the preferred stock the better and surer investment from a pure dollars and cents viewpoint, but of course purchasers of preferred stock are denied a voice in the management or a place on the board of directors. It is only in such rare cases as this that you might be able to sell any preferred stock at all at the start, because people can get 7 or 8 per cent on their money in any number of safe, established concerns, whereas your company will be quite speculative from an investment standpoint for two or three years.

The dividend arrangement I explained just above is a very good way to provide for some of your employees. Preferred stock does not usually satisfy employees even though it may be given them outright. The reaction is: "Thunder, I'll get that 7 per cent anyway, there's no chance for it to be any more, why should I work any harder?" But with the possibility of increased dividends through harder work, the reaction will be quite different, and yet there will be none of the embarrassing unpleasantnesses which often make it impossible to consider common stock for any employees, even the foremen or superintendent.

Holders of stock in a corporation are only liable for the par value of the stock they hold, so the one objection to a partnership is eliminated by that fact. The corporation is, from a legal standpoint, a definite individual or "entity," having an existence entirely separate from its members, and having rights and responsibilities in law that do not affect its members as individuals at all. Even though you may plan to raise only $5,000 from a single individual you will find it a wise practice to incorporate for "enough." While that sum may take care of your immediate needs you cannot tell what expansion you may wish to undertake five or ten years from now; and if you provide for that in your original charter you will save yourself considerable expense and the inconvenience incidental to putting through an "amendment."

In giving you these few bits of information and suggestion I have wanted to guard you against some of the costly mistakes which I have made in my own personal experience. I have not tried in this chapter to duplicate the details you will read in some of the books on corporation management and accounting because I have felt that you could get a better and more usable grasp of the "meat and potatoes" of the subject if I permitted myself to be rather informal in discussing it.

The first time I entered business for myself three of us formed a partnership—one man contributing $5,000 in cash. We had thought that amount was entirely sufficient to put us on a sound, safe basis. But we did not take into account the continually increasing cost of materials and labor at that time. We did not anticipate the steel strike which made cold rolled steel more scarce than the proverbial "hen's teeth." We did not know that the first week after we turned our $400 worth of patterns over to a jobbing foundry, that foundry was going to burn down to the ground. There were lots of things we did not know at first. So it was

not six months later that we needed another $5,000. We did not have that amount ourselves; we could not borrow that much at our bank; so we had to enlarge the personnel of our company. We incorporated at that time for $200,000 despite the fact that our total cash investment was only $10,000. The stock was evenly divided into common and preferred (the preferred has not yet been touched), and I shall always believe that our capitalization was not at all disproportionate to our cash investment.

The Basis of Smooth Progress

In associating yourself in business with other men align yourself with men you know you can trust, *and then trust them.* No progress, no success can grow out of lack of confidence or lack of co-operation. Whether it be money or inventions or services or ability, all of you have some very tangible investment in your business and a very vital concern for its growth and development. There will come times when disagreements will creep up—no two men with keen minds could be expected never to disagree. And so there will be times when you will have to compromise even though you prefer not to do so. But it is at such times that you must let yourself and your desires be secondary to the ideal which urges you on and makes your effort worth while. Your partners may offer suggestions about design or production which will appear to you as absolutely ridiculous. And yet you may propose plans for the management of their part of the business which will be equally impracticable. But two minds are better than one. So in taking others into your organization select those who can fit into a gap which you cannot pretend to fill.

My last thought is a sales suggestion, a thought for you to use in selling your proposition to your partners. Don't play up the possibilities of your business in glowing terms for which you may later be called to account. Don't put in any camouflage or "hocus-pocus." Business men want information—straight, cold-blooded, truthful, reasonable facts from which they can judge the wisdom of the proposed investment. Lay your plans and your problems before them. Put all the cards on the table, if I may use that expression; for if you do not conceal any detail, ever so slight, or if you do not give the possibility of a misunderstanding or a misinterpretation you need have no fear of facing the time when your partners can say, "That wasn't the way we understood it when we put our money into this company."

Strength of Pipes as Columns

By John S. Watts

The chart which accompanies this article, will be found to save considerable time and labor in calculating the size of pipe necessary to support a given load as a column of a given length. For relatively small loads the standard pipe furnishes an economical and easily made column, and also for long reach rods, such as are sometimes necessary to transmit the push from a hand lever, the pipe section is an ideal one.

All column formulas vary the safe stress with the ratio of length to radius of gyration, which involves a process of trial calculations as it is necessary to assume a diameter of column, to know this ratio, and if this diameter proves too light or too heavy, to try another diameter and so on.

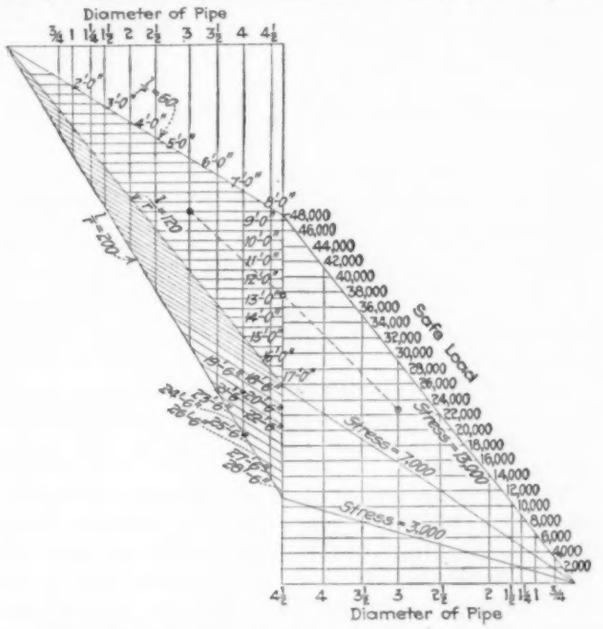
The formula upon which this chart is based is that used by the American Bridge Co., in which the stress allowed for ratios up to 120 is found by the formula

$$f = 19{,}000 - 100\,\frac{l}{r}$$

with a maximum stress of 13,000. The stresses for ratios between 120 and 200, are found by deducting 500 for each increase of ten in the rotio above 120, from the stress allowed for the rate of 120, which is 7,000.

A ratio higher than 120 should not be used except for temporary work, or for a column which is fully loaded only occasionally.

To illustrate the use of the chart, we will determine the safe load on a column made of a 3-in. pipe, 8 ft. 6 in.



long. From the upper left-hand corner of the chart, we draw a line through the intersection of the horizontal line for the 8 ft. 6 in. length, with the vertical line for the 3-in. pipe, and produce it to intersect the central vertical line. From the intersection so found, we draw another line to the lower right-hand corner of the chart, and where this line intersects the vertical line for the 3-in. pipe, we read off the safe load on the horizontal lines as being about 22,800 lb. These diagonal lines are marked on the chart to make the explanation more clear. We see at a glance that the ratio $\frac{l}{r}$, is well below the limit of 120.

In practice it is more likely that we will be required to determine the size of pipe of a given length, required to carry a given load, and I will illustrate next the method of solving this problem. My reason for using the above example first being merely that the explanation would be more easily understood, by taking that problem first.

Taking then, the same figures, we are required to determine the size of pipe required to carry a load of 22,800 lb. as a column 8 ft. 6 in. long. Taking a thread stretched from corner to corner of the chart, we draw a pin against this thread, and travel it up or down the central vertical line until the thread intersects a diameter vertical at the given load, in the right-hand triangle, and the same diameter at the given length, in the left-hand triangle.

Cylinder Grinding in Motor Repair Shops

Practical Suggestions for the Service Station Man—The Cost of Work in Various Localities—Cylinder, Piston and Crankshaft Work

SPECIAL CORRESPONDENCE

IN THESE days when motors are being repaired rather than discarded it behooves the repair man to know how to secure the best results at a reasonable cost. Cylinder wear is undoubtedly the most costly from the standpoint of economy and there is little question as to grinding being the best way of restoring a worn cylinder to its original accuracy, or even of improving it. Pistons, piston pins and crankshafts also require attention.

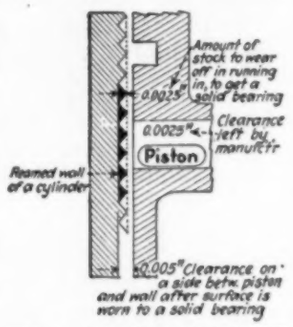

Amount of stock to wear off in running in, to get a solid bearing
0.0025"
0.0025"
Clearance left by manuf'tr
Piston
Reamed wall of a cylinder
0.005" Clearance on a side betw. piston and wall after surface is worn to a solid bearing

FIG. 1. EFFECT OF ROUGH CYLINDERS

The following suggestions have been collected from the wide experience of the Heald Machine Co., of Worcester, Mass., in regard to cylinder regrinding work and will, we are sure, be very helpful to real motor repairmen everywhere.

One of the most accurate and convincing ways of showing the advantages of grinding over either boring or reaming automobile cylinders, is by the grinding machine itself.

Take a block which has been finished by boring or reaming and set it up on an angle iron on a cylinder-grinding machine. Carefully line it up, and then let the wheel run in and out with just enough feed to spark. The result will be surprising. Not only will the reamer marks show up plainly, but it will also distinctly show high and low surfaces.

Decidedly bright spots will indicate a hard place in the iron which the reamer jumped over. This test also proves definitely whether the hole is at right-angles with the base or not; for if it is not, the wheel will grind on opposite sides at the ends.

Note definitely how the reamer marks are brought out when the porous-like surface is ground away. This demonstrates that a reamed hole will wear much quicker than a ground hole. In withdrawing reamers scratches from 0.002 to 0.003 in. deep are sometimes left by the reamer blades.

When the piston and rings are assembled in the cylinder they will rest on the minute hills of metal as exaggerated in Fig. 1. About half the bearing surface is thus lost, due to the depression of metal between each two hills. A full bearing surface is not realized until from 0.002 to 0.005 in. of metal has been removed by the piston and rings. This causes a very rapid wearing of the cylinder wall until it is worn to solid metal. The extra amount worn off causes a large percentage of gas and oil leak past the rings.

For instance, the amount of clearance allowed by the manufacturer between the cylinder wall and the piston in this particular case is 0.005 in. In order to get down to a solid bearing, another 0.005 in. of wear is necessary, making a total of 0.010 in. clearance between the piston and the cylinder wall. A few thousand miles of use, and this block will begin to cause trouble.

The space between the wall of the cylinder and the rings, which has been definitely determined, soon enlarges so much that there is a noticeable loss of power and leakage of oil. This is one of the reasons why cylinders that are not originally ground require to be reground and fitted with new pistons and rings much sooner than those that have been finished by grinding.

Too many repairmen are still advising new rings when an owner is confronted with motor troubles. They believe it is a cure, but it is only temporary, since in most cases the carbon has been cleaned out, valves ground and motor generally tuned up. It therefore seems to have overcome the ailment. It is not lasting, however, for no matter how expensive or complicated rings are used (with or without compression guaranteed), a round ring will not fit an egg-shaped hole; and if the motor has been run that is what you will have.

Thousands of strokes of the rings up and down the cylinder, aided by road dust and other abrasives sucked into the cylinders with the mixture, will gradually wear down the cylinder wall. This wear is greater on the two sides at right-angles with the crankshaft. It is due to the pressure of the piston against one side of the cylinder wall on the compression stroke, and on the opposite side of the cylinder wall on the power stroke. No ring will fit such a shaped hole, so there is bound to be a chance for gas escaping and a long time for the rings to wear in, if they ever do so. Therefore, as the cylinders are only worn the length of the ring travel, it leaves the lower and upper ends smaller. To put a ring the proper oversize in the worn part through the smaller hole is impossible. The only cure for a worn cylinder, and it takes but a few thousandths to show appreciative loss of power, is to have the cylinders reground and fitted with new pistons and rings. Fig. 2, which has been somewhat exaggerated, shows the wear in a cylinder which may have been made by various causes. Note how the gaps in the rings are spread, allowing for gas to pass through or around the rings.

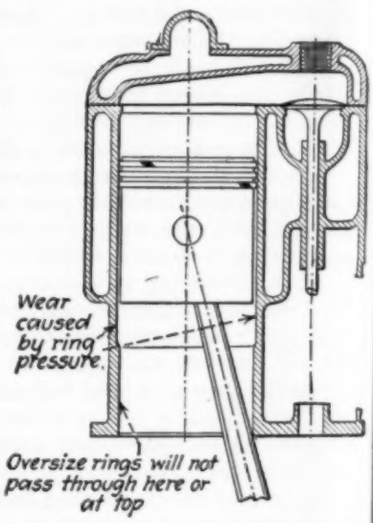


FIG. 2. HOW A CYLINDER WEARS

New rings in such a worn cylinder would do no good, unless of the correct size to fill this hole. This is impossible, since rings of the proper size would not pass through the space either at the top or bottom of the cylinder. It will require grinding to take out sufficient stock to allow proper oversize pistons and rings to be inserted.

When the statement is made that a reground cylinder which has been fitted with new pistons and rings is better than it was originally, few people can understand why. It is a well-known fact that castings change shape after they are cast. This is due to strains and stresses caused by the heavier walls of metal cooling last and shrinking away from the already cooled lighter walls.

These strains can be relieved if the castings are seasoned for a long time, or by heat-treating processes. Castings that are immediately machined and put to work in a car, change their shape more or less, due to the heating and cooling of the motor that acts as a heat-treating operation. Therefore, a motor which has been run several hundred miles is thoroughly seasoned and is in ideal condition to be reground and fitted up. Once having been relieved of all the strains and stresses, the castings will retain their shape continuously after grinding, if properly machined.

Cars that do not run right, that use excessive amounts of gas or oil, lack power, or smoke excessively, need overhauling. A disagreeable piston slap is a sure sign of worn cylinders. This is usually heard on hills or when the engine is laboring hard.

After it is taken down, it can best be determined whether the cylinders need to be reground or not. If found scored, out of round, or with excessive clearance between the piston rings and cylinders they certainly need regrinding. All cars that have been run two or three years should be pulled down, have the cylinders reground and fitted with new pistons and rings. Makes of cars where the cylinders were not originally ground are subject to regrinding sooner than those with originally ground cylinders.

If the cylinders have been welded for any purpose, such as a score or a crack, they must be reground. Welding distorts and changes the shape in addition to leaving excess metal. Only by being reground can they be brought back to true, round, smooth holes.

With commercial cars or tractors, the same reasons for regrinding hold true as with pleasure cars, except the regrinding should be at least once a year. They are usually worked constantly to their full capacity and are required to perform tasks which require every ounce of power. Reground cylinders will save money for the owner on all commercial motors. Tractors in particular, are subject to excessive wear, due to the conditions under which they must work and the dust and dirt working into the engine.

While there are a number of convenient dial gages for measuring cylinder bores, it has been found that, in regrinding shops, ordinary inside micrometers are the best for all-around use.

In manufacturing plants where the size of bore runs the same, dial gages are far superior and faster. Where one is jumping from one size hole to another, as happens in the ordinary regrinding shop, nothing that we know of will take the place and give the speed and accuracy of standard inside micrometers.

All holes in the same block should be ground as nearly to the same size as possible. This was not always done by the first companies to take up regrinding. Many times, when the differences were slight, the pistons got mixed in the assembling, and the wrong piston would be used; then trouble developed. Keeping all cylinder bores in a given block the same diameter makes a more perfectly balanced motor and in case of repairs it is easier to refurnish them from the records kept by the regrinding company.

Occasionally the shifting of the cores, when molding the cylinders, leaves a thin wall. In regrinding such cylinders if the wheel should break through the man doing the work cannot be held responsible for this misfortune. Furthermore, should there be a deep score and the owner wishes it ground out instead of filled, he must assume all the responsibility for later trouble.

It would be better business for all regrinding concerns to refuse to touch such jobs, if, in their opinion there is a doubt as to what the strength of the wall will be after grinding.

(*Continued in next week's issue.*)

Aligning Shafting by a Steel Wire

By W. F. Schaphorst

The article "Aligning Shafting by a Steel Wire" by Henry J. E. Reid on page 790, Vol. 54, of *American Machinist* is interesting. It strikes me that the wire method is very good for horizontal adjustment, but for vertical adjustment I call it too cumbersome for general adoption. I do not question its accuracy but it appears that much time is required to rig up the apparatus in the first place, weights of known quantity must be obtained, the distance between supports must be absolutely accurate and each end must be given the same exact elevation.

For horizontal adjustment only, a similar wire arrangement will serve the same purpose just as accurately without the refinements of exact weight, exact heights, and exact distance between supports. Then, to adjust the alignment vertically use an ordinary rubber hose with a gage glass inserted into each end. When the hose is filled with water the level will always be the same at each end and it becomes a simple matter to move the end fixed to a post to the other end along the lineshaft and make accurate vertical adjustments. In this way accurate alignment may be made both vertically and horizontally without any mathematical computations whetever and without tables and charts.

In checking up the table of sags on page 791 I get a result only one-half as great. Possibly it is because the tension in the wire is only 60 lb. instead of 120.

In checking the statement "2 $\times$ 60 is the force applied to each end of the wire," I have used the formula given in "Marks Mechanical Engineers' Pocketbook," page 756, which is:

$$S = \frac{WL^2}{8T}$$

where

W = wt. of 1 ft. of wire
T = tension in the wire
L = the span in feet
S = the sag of the wire at the center in feet.

Applying this formula to the figures given by Mr. Reid, we have

$W = 0.0009$
$L = 320$ ft.
$T = 2 \times 60 = 120$.

Substituting in the formula, we get

$$S = \frac{0.0009 \times 320 \times 320}{8 \times 120} = 0.096 \text{ ft.} = 1.152 \text{ in.}$$

This is the sag in the middle where $L = 160$ ft. and which, according to Mr. Green's table, is 2.303 in. Since 2.303 is just twice as great as 1.152 it is my belief that the weight used by Mr. Reid is 50 lb. instead of 2 $\times$ 60 pounds.

Incentive or Production Basis of Wage Payment

III. Assignment and Recording of Production—Co-operation with the Workman—Fitting the System to the Conditions—Securing Co-operation of Executives

By HENRY H. FARQUHAR

MAXIMUM results in production can come only when the workmen themselves are thoroughly behind the plans, and they cannot be thoroughly and intelligently behind anything of which they are not completely and fully informed. It follows, therefore, that as regards the part they are asked to play, there must be a perfect definiteness and a policy of laying all the cards on the table at all times. Translated into action in assigning and following up work, this means simply that we determine what each man should do, that we tell him in advance what is expected and that we provide means for measuring what was done against what should have been done. Each of these requirements is discussed in more detail below:

Rec'd / Iss'd: APR 15 1920 7 70 AM — Charge to: 147

Name: 7. Howard — No.: 483 — Dept.: DB

Operation and Instructions: nail #9

Mach.	
Amt. Req'd	900
Amt. Fin. Good	
Waste	
Job Fin.	
Job not Fin.	

Elapsed Time	Class	Rate	Earnings	
	2.70 hrs. = 333 per hou.			

Payroll	Cost	Prod'n			Approved:
					Foreman

FIG. 2. JOB TICKET USED FOR PLANNING, FOR TRANSMITTING INSTRUCTIONS TO THE OPERATOR, AND FINALLY AS A RECORD OF PERFORMANCE AND COST

(14) *Each man should, so far as possible, have a clearly defined amount of work scheduled ahead of him.*

This, of course, is not possible in all cases, yet if sufficient investigation of miscellaneous work be made it is surprising how much of it can be put on a definite schedule. I know of one factory where the work of the janitors has been so thoroughly investigated and standardized that they may not only follow a logical procedure in their work but also receive a bonus for performing it in an agreed-upon time. The work of a maintenance department is about as miscellaneous as that found anywhere, yet in another large mill the activities of this department have been carefully planned for years, and today through the use of elementary time studies gathered during the past two years, on practically all repair and construction jobs which come up a standard time is set and a bonus paid, with the result that breakdowns have been almost eliminated, production doubled, wages increased and costs decreased. In still more difficult cases I have offered a reward to good advantage, not for accomplishing a specified amount of work in an agreed-upon time, but for performing to the satisfaction of everyone served all duties which were assigned. The next class of duties difficult to measure and therefore difficult to reward in exact proportion to accomplishment is creative work, but this together with administrative work may be and often is rewarded, not on the basis of time at all but on the basis of results.

The measurement of work is an extremely important part of the manager's job, and the subject is worthy of much more discussion than can be given here. I trust that the foregoing examples may serve as food for thought for those who have possibly considered strictly repetitive work as the only kind susceptible to measurement sufficiently accurate for some form of incentive payment.

(15) *Each man must be informed in advance what he has to accomplish to earn additional reward, and he must be able to measure currently his performance against this standard.*

The principle of letting a man know what is expected of him under given circumstances is no more than his due, but more than this it is imperative, if he is not to be left to work in the dark. It also adds interest to what otherwise might be monotonous work, and gives him the opportunity to protest in advance if he considers allowances unreasonable. Fig. 2 shows a job

Name 7. Howard No. 483 Date 4-15 1920

Your TIME AND EARNINGS on above Date were as Follows:

RATE: Base $.83 — Bonus $.67 — Day $5.83 — Overt'm $.12½

OPERATIONS: P-Print L-Lock Cor. F-Frame T-Trim N-Nail

	Operation	Mfg. Ord. No.	Shook No.	Quantity Fin.	STAND A	ACTUAL B	SAVED C	LOST D
BONUS WORK	N	147	9	900	2.70	2.77		.07
		583	160	180	.46	.40	.06	
		1597	2	200	.75	.68	.07	
		1593	3	200	.75	.82		.07
		613	257	900	2.23	2.20	.03	
		491	183	40	.30	.22	.08	
		486	1	230	1.10	*1.10	-	-
							.34	.14
	TOTALS-This Day				$8.29	$8.19	= 101.0 %	
	TOTALS-To Date				77.53	75.27	= 103.0 %	

EARNINGS-Bonus W'k. [4/5 x] Bonus Rate if Made / Base Rate if Lost = $ 5.50 — TOTAL EARNINGS

Overtime [B x ½ Base Rate] 5/8 x .2915 = $ .32

TOTAL BONUS EARNINGS $ 5.87

DAY WORK: Filing Saw 166 x .02 = .97 — Cleaning up *.20 x .75 = .18

TOTAL DAY WORK $ 1.15

NOTE In case of disagreement with this statement report at once to the undersigned. TOTAL EARNINGS $7.02

Signed R. S. Snow

FIG. 3. EARNINGS SLIP GIVEN EACH DAY TO EACH OPERATOR. THIS IS A SUMMARY OF JOB TICKETS ILLUSTRATED IN FIG. 2

ticket which is used first in planning, then for transmitting orders and instructions to the operative, and finally as a permanent record of performance.

To make this advance notification effective, each man must be able to check his own performance currently (as he works) just so far as is practicable. The entry

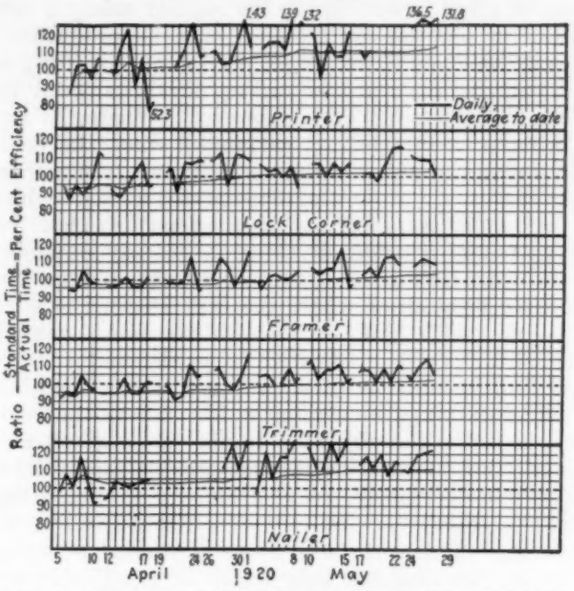


FIG. 4. PERFORMANCE CHART DISPLAYED IN THE DEPARTMENT. THIS IS POSTED FROM EARNINGS SLIPS

of the number of pieces per hour on this job ticket (Fig. 2) illustrates this important point. If the workman is to respond to the standard it must be translated into terms which he readily understands. Thus, to him the significant figure is the *rate per hour*, so that in addition to saying that these 900 pieces should be processed in 2.70 hr. we also say that the *rate* for this job is 333 *pieces per hour*. This he readily compares with his usual speed on such work.

To follow up the practice suggested in the last two paragraphs, each workman should be notified by the management, preferably daily, as to his performance as shown on their records. This, besides helping to sustain his interest, will enable him to bring any discrepancies daily to the attention of the management and avoid a peak load of complaints and adjustments following pay day. Fig. 3 illustrates one method of notifying each workman exactly how he stands each day, this being a summary of job tickets as shown in Fig. 2.

Importance of Record-Keeping

Lest so much attention be given to looking ahead on all of the matters covered in the preceding discussion that we forget that it is usually imperative to be able also to look back, another most important provision is necessary.

(16) *The operation and results of the method must be supported by adequate records.*

Without these suspicion and trouble is almost sure to result. Such records, illustrated in part by the job ticket, are for the purpose of enabling both men and management to verify the accuracy of all figures when the inevitable questions and complaints arise; of furnishing individual man-records with all that these serve in settling questions of a man's fitness for given work and of relative earning power and ability of the various men; and of preventing the tendency (through showing up each man's own individual story) to blame others and shift responsibility. They also of course serve many other uses in connection with the administration of work and accurate cost finding.

Period Over Which Performance Is Determined

A task and bonus method of payment was recently thrown out of a factory because the individual job was used for figuring earnings instead of a longer period (say a day) which should have been used. In this case certain uncontrollable delays entered into the men's work, and in making allowance for these in the standard times the *average* delay was used in all cases. This was all right when the average job came along, was entirely agreeable to the men when less than the the average delay occurred, but anything but satisfactory when more than this time was required. On jobs of this last class, the men lost bonus even though they worked just as hard and as faithfully as they did on any of the others. Naturally at such times they pawed the air, and a perfectly good system of pay was discredited in both the management's and the men's eyes because they did not see what the matter was. A rule never to be forgotten is:

(17) *The period over which performance is figured should be as short as possible but never so short as to be unfair to the workman.*

Where uncontrollable elements such as breaks occur in processing a product which we finished but did not originally manufacture, since the time allowance for our operatives must ordinarily be based on the average break, either sufficient time must be included in the performance period so that extraordinary delays will be brought down by the lesser ones to the average figure, or later adjustments must in fairness be made.

Eliminating Detail

The same thing holds true where for any reason, such as considerations of expense, the time studies are not complete or final in every particular. Thus, in one case of making boxes, it seemed impracticable and unnecessary to get detailed times on every single one of the hundreds of different types and sizes of boxes made. Instead, all boxes were classified as best we could into small, medium, and large, on the basis of cubic capacity; then accurate times were obtained on several sample boxes in each of these classes. The capacity basis is probably the best but not a perfect measure of the difficulty of handling a box, and there were numerous contrary boxes which refused to fall into line at the proper point on the resulting curve. These exceptions as they were discovered were each made a separate class from the general run, but how many such "exceptions" there might be which we had not happened to time no one could say. It was necessary, therefore, rather than be forced to make constant annoying adjustments, to take this fact into consideration in developing the method of pay for this special case. The answer was simply to make the day's work (consisting of several different jobs on several different kinds of box) the basis of figuring performance instead of the individual job, in the expectation that over this period the high and low times would compensate each other. This, after the men understood it, seemed to be perfectly satisfactory and resulted in few cases of lost bonus (see chart, Fig. 4).

Fig. 3 is a reproduction of an earnings slip showing

how this worked out in practice from a summary of individual job tickets issued during the day. Here this man lost the first job by 0.07 hours, made the next two by 0.06 and 0.07 respectively, lost the fourth by 0.07 and so on, but earned a bonus on all these jobs because the sum of the times he saved during the day exceeded the sum of the times he lost—in other words he was given 8.29 standard hours work to do, which he did in 8.19 hours, entitling him to bonus rate on his day's work as a whole.

Length of Bonus Period

In another plant on a different kind of work the same general scheme is used except that even a longer period, in this case a week, is used. I understand that some engineers recommend that a month be used (although with a different method of payment), but this seems a little long even for incomplete standardization and inadequate time study. The objection here is the same as one of the many objections often cited to profit sharing in that it is difficult to sustain the interest of the men over so long a period, and a consideration of when and why "efficiency" pay was not earned becomes too much of a post mortem.

One other angle to this question of the proper length of period may be indicated before passing on. Regardless of how long a time is used as a basis of determining reward earned, there is still the question of the proper duration of each job assigned. All that can be said here is again to choose the middle road—a series of short jobs during the day becomes a nuisance to both the men and the timekeepers, while too long a job also has its disadvantages. With investigation and rearrangement of processes it is often possible to build up short jobs or break down long ones into operations of a half day's duration or thereabouts, which seems to be about the happy mean.

In the last analysis the success or failure of any internal plan of management rests very largely upon the foreman. If he is behind the plan and wants it to go it goes, and if he is against it it likewise goes—out. It is therefore most important that his co-operation be secured, and that his intimate familiarity with all details of the work be taken advantage of in setting standards and in devising and operating the incentive method. No matter how carefully thought out beforehand, there will almost surely be irregularities and weak places in the plan which no one on the one hand can use to more telling effect in damning the whole scheme if he so desires, or on the other hand straighten out so satisfactorily as the foreman. This helping over the rough places throws a considerable burden upon him which should receive recognition, and a satisfactory manner in which to recognize it is expressed in the following recommendation:

(18) *The foreman should receive an additional reward according to the total efficiency of his department.*

It must be emphasized at the outset that where this practice is contemplated final authority in passing upon quality of work must be detached from the foreman. This is good practice in any event, since the man who is primarily responsible for *quantity* of work should not ordinarily be expected to exercise an impartial judgment as to quality of that work; but certainly where volume of output is one of the factors in adjusting the foreman's pay he should not be put to the temptation of swelling quantity at the expense of quality. Let him fight this matter out in doubtful cases with one not under his jurisdiction who is interested solely in the accuracy of what is produced, not in the quantity turned out.

Such a reward to the foreman may be based either on output, on workman's earnings, or on cost—that is, he may be given in addition to his regular salary a rate per piece or per ton for example, on total production; or he may be given a definite proportion of earnings; or or he may be rewarded according to the amount by which a predetermined cost is lowered. Where the second basis is used (that of earnings) when the operatives under him are working on piece rate, the reward should begin only after a predetermined amount which may be readily reached has been earned so that low production will not add anything to his pay envelope; and the same provision should hold with any method other than piece work where the task element is similarly weak; with task and bonus payment, however, where earnings are predicated on predetermined high production, he may be given a percentage directly on amount of earnings (including bonus) above the regular day's pay. The objection to the last method enumerated (that of cost) arises through the fact that, as pointed out previously, cost is subject to fluctuation through so many factors over which the foreman has no control. Which of these bases is chosen is largely incidental, however, as long as it is practicable and furnishes definite incentive to continuous high production.

I wish to put a ring around this topic by reverting back to the first paragraph to emphasize the importance of relieving the foreman of final responsibility for inspection in all cases where his earnings are dependent on volume of work turned out.

The Method of Pay

Up to this point the whole discussion has dealt with the prerequisites to production reward, and it would seem that the least important topic—that of the method itself—had been reserved for the last. If thereby emphasis can be laid on its relative unimportance, its place in this paper is justified.

From one standpoint, however, and that a negative one, the details of the method to be adopted are most important. By this I mean that it is imperative not to choose a *wrong* method under particular circumstances lest the possible benefits of the various features enumerated be neutralized. Judgment must be exercised not so much as between the various good methods available, as between the good and the bad, for with any given set of conditions there are usually many bad and several good ways which might be used. Some guides in making this choice are indicated in the closing discussion.

(19) *The method of pay must be easy for the workman to understand and to calculate.*

As has been emphasized, maximum response cannot reasonably be expected of the workmen unless they thoroughly understand what it is all about and just what part they are asked to play. A strictly logical basis of reward may fail and has failed in practice because the workmen could not follow the logic nor figure the results. Just as the standard must be expressed in terms which he can understand (see topic 2), so the method of determining his pay when he reaches or fails to reach the goal must be intelligible to him. This of course is not possible in every case with illiter-

ate or uneducated workmen, but it is extremely desirable in all cases, and the more uneducated the men the simpler must be the scheme.

Features of Various Systems

Among the better known incentive methods (leaving out of account the non-incentive day rate which is at once the simplest and, as ordinarily used, least effective method), the straight piece rate and the Taylor differential rate are readily understood by almost any worker. When we come to the premium methods—Halsey, Rowan, Barth, and so on—the calculation is somewhat laborious but may be made by the average workman without difficulty. In the same class falls the Gantt task and bonus as ordinarily used; but with the almost innumerable combinations of these, with the Emerson "efficiency" method and with other sliding scale or inclined plane types the complexity increases beyond the ability of the average workman to grasp, and to this extent they lose practically any theoretical advantage they may possess. This disadvantage is only to a slight extent overcome through slide rules or other means by which workmen may, with some difficulty, figure their earnings, and such paraphernalia does not overcome the objection that with most of such schemes the workman cannot check his performance as he works. It follows, of course, that in accordance with topic No. 16 the records must be in such shape that they are readily available for checking the figures finally arrived at by the men; they must be asked to take nothing for granted.

One Necessary Feature

Against the various advantages and disadvantages of these plans from this standpoint must be put those affecting the feelings and productivity of the operatives. There are two sides to every question, and while some methods appeal to the workers themselves more than other plans do, the welfare of everybody, including the workmen, must be considered from the standpoint of high production and low costs. Without making an attempt to give reasons in detail for my personal preference in the matter, I will state finally what I consider a most important rule:

(20) *The method of pay should embody the "task" idea.*

This, I realize, is a debatable point, particularly during dull times when the workman sees goods piling up to such an extent as to neutralize any incentive appeal to high production. One illustration of why I feel as I do may be given. The output of an operative on a job where his own speed practically determined the amount produced was originally 100 pieces per day. He was paid a piece price of $0.03. A production of at least 145 was desired and the workman was asked to produce this amount. This request being without effect, the piece price offered was increased to $0.0315, but the output remained stationary. The task was then brought into play. The man was told that up to 145 pieces he would get $0.03 as before, and that from 146 to 180 he would get $0.0315 for all pieces produced. He immediately brought his production up to 157 per day, which gave him a rate of $0.0315—or the same rate that had failed to tempt him while under straight piece work. No changes whatever were made in the administration of his work. Later another man on the same job under the same conditions of work but with the new differential rates raised the output to 214 per day and held it there for a number of years. This fact in itself is sufficiently striking, yet at the end of this time the task element was more strongly emphasized by putting this work on Gantt task and bonus, whereupon the same man jumped his output within a few weeks to 246 pieces per day, a small proportion of this last increase being due to slight modifications in the routing of work. Starting with 100 pieces, therefore, the task was responsible in this rather exceptional case for an increase in production of over 140 per cent. Similar stories of increases in production are common in passing from day work to one of the incentive methods, but I know of no more striking instance of the value of the incentive methods which embody task work to a high degree (such as the Taylor differential and the Gantt task and bonus) over those which do not.

The Task Idea

There seems to be something irresistible about task work when the task is properly set. It seems to push a man up from below and pull at him from above as nothing else does. This is well illustrated by the chart, Fig. 4, which shows a running record of five men making boxes under the method of payment described in topic (17). This is a photostat copy of a chart kept before the men and regularly posted from the earnings slips shown in Fig. 2. It will be noticed that the framer resisted the pull for nearly eight weeks after the bonus method was put into effect, but with the more and more frequent earning of the extra money, coupled with the example of the other men, his performance finally rose and remained above 100 per cent. This represented an increase in production of something like 15 per cent over what had formerly been considered excellent performance.

One final caution in deciding what form the task is to take: In a sense almost any incentive method of pay may be said to incorporate the task feature, yet in many methods (such as the inclined plane type of payment) it is embodied to such a slight extent as to be practically non-effective. There should not be too many "steps" in the reward—a fairly high standard should be set and the men required to reach this standard before additional payment is made. This standard may be expressed in any one of a number of ways, but the feeling of satisfaction in having attained it must not come too soon or too easily if we are to guard against the tendency to settle back on what laurels we have won. Only through a rigid standard are two great benefits of task work as regards the men themselves to be realized: that of assisting in ascertaining the fitness of a given man for a given kind of work, and that of distinguishing between good, and poor or lazy, men. These should not share equally in the reward, as they may if the standard be too low, but each according to his individual merit.

A Final Word of Warning

I cannot close this paper without adding what perhaps does not strictly belong here: A word of warning to those who contemplate initiating a bonus or other plan of production payment. It is not sufficient that the various features which have been discussed be carefully provided for, for they may come to naught through a false start in putting the plans into effect. I speak from bitter experience in attempting to start several operatives on a new plan all at once, in spite of many warnings not to do so. No matter how care-

fully thought out one's plans may be, there are always some loose ends which are bound to make trouble in geometrical ratio to the number of men one attempts to deal with in such matters at one time. Under the best conditions the management must be prepared to suffer a good deal of agony during the development of new methods, and so if possible the start should be made with one man who has been carefully selected for the purpose, and followed up with one at a time similarly selected. If the plan will not work with one, it will most assuredly not work with more than one, while on the other hand if one or two be thoroughly sold, there will ordinarily be little trouble in getting it across to the rest. The results of months of expensive standardization and planning—those essentials of high production which I have so constantly emphasized—have on more than one occasion been wiped out through failure to follow the procedure indicated. With success at the start pressure will be brought to bear soon enough by the men for the extension of the work, and for maximum speed in the long run the surest way is to make haste exceedingly slowly in the beginning.

Stabilizing a Business by Proper Accounting

By J. Bainter

"WHY think of war in time of peace?". The reason is, as demonstrated to us not so long ago, that we may be prepared.

The same line of reasoning applies to industry and business with relation to good and bad times. Without wishing to cast aspersions or to make an unkind statement, we feel constrained to say that many business enterprises are at this time suffering because they failed to consider in a golden period the troublesome days that the future might bring.

True, at present practically all industry has felt a slump; but the attitude of the personnels of different concerns toward present conditions vary greatly. The biggest men and the most farsighted men, as a class, are philosophical about matters. They were not surprised by a big falling off in business, because they fully expected it. The concerns that had wide-visioned men to pilot them through the past few years are, as a rule, not now in dangerous positions financially, for the reason that a full knowledge of the various phases of a problem goes far toward providing a solution.

Now, getting to the point, it seems not amiss to mention something about the conducting of business enterprises, at a time when the logic of the argument has been borne out and has, therefore, considerable weight. Since every business organization realizes that there will come to it bad times, as well as the prosperous periods for which it was organized, some means should be adopted to utilize the earnings of one period to carry the losses of another. In this way, stability can be given to an enterprise.

To accomplish this purpose, many cost accountants favor the establishment of burden reserves, or sinking funds of a special type. The idea is based on the knowledge of the average burden for, say, ten years past, this moving average being considered as "normal."

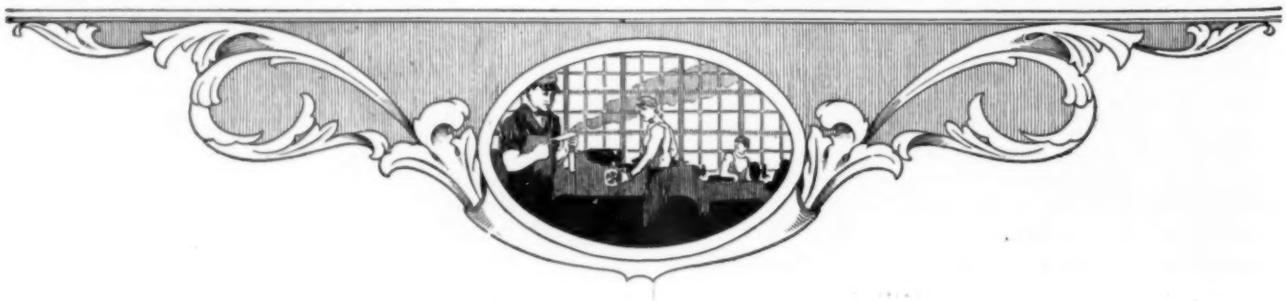
The burden charges per unit of product depend directly upon the amount of production, other things being equal. That is, the general overhead expense, including the cost of such items as administration, office maintenance, insurance, taxes and depreciations, that must be borne per unit of product is greater when production is low. That is our condition at present.

Not long ago, however, when business was good, the burden rate was small—a condition which the future will again bring. Now, the desirable thing is to stabilize a business by making the low rate offset the high rate of another time. There are several methods of doing this, but the burden-reserve method already mentioned is probably the most sound. The details of it are, of course, left to the accountants of each individual plant, but the principle is the charging or crediting to the burden reserve each month the over-absorbed or under-absorbed burden. It is well to add that the success of the plan depends somewhat upon the proper choice of the normal burden rate, which must be determined by the use of the cost data gathered over a period of years.

The few firms actually using the system have been well repaid for it now. As for the others employing cost systems, if in 1915, each had established a reserve to which was credited over-earned burden, they would have something to meet the high burden rate of today. Now, however, it is necessary to start on the wrong side of the account. But, when the cycle has been completed, the account should be balanced and we should be ready to meet the next depression with a smile.

Tungsten

Tungsten, which has come to be known as one of the most valuable of the metallic elements yet discovered, is obtained largely from an ore known as wolframite, found both in Korea and in the United States. It is extracted from the ore in the form of a powder, which is formed into ingots by hydraulic pressure instead of by fusion, as is the case with practically all other metals. The melting point of tungsten is about 3,350 deg. C., which is higher than for any other known metal, and when tungsten cools, instead of being softer as is the case with other metals, it is just as brittle as it was previous to the heating. A process of mashing the grains of metal so as to make it ductile while cold was finally evolved, with the result that it is now drawn into filament for incandescent lamps, doubling the efficiency of the lamps and providing a whiter and better light than any lamp before known. The tungsten filament has a remarkable tensile strength—about 600,000 lb. per square inch for wire 0.001 in. in diameter.

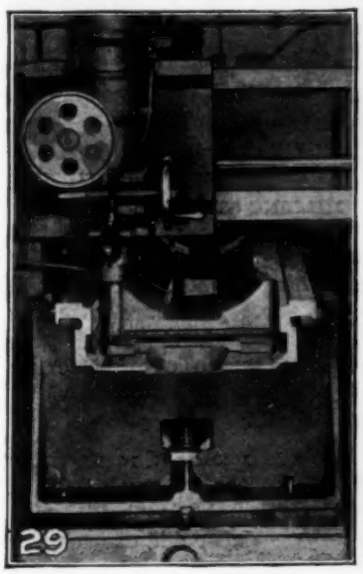


Manufacturing With Special Machines vs. Standard Equipment

IV. Portable Devices for Plain and Thread Milling—An Angular Drilling Fixture—A Special Machine for Milling Sinuous Oil Grooves

By Col. F. Jenks* and M. H. Christopherson†

Operation 31, Fig. 29, shows finish milling the breech end, the bevels underneath the forward gunlock and on top of the rail. Ten Otis type-11 and two type-12 vertical milling machines were used on this operation. The peripheral cutting speed was generally 50 ft. per minute. The time on the first of 120 sleighs was 120 hr. each. On the next lot of 160 sleighs the average time was 60½ hr. Average time on ten sleighs with experienced men was 48½ hr. which could readily have been maintained. The time on this operation at the Arsenal was 56.83 hr. Cutting compound was used on the cutters. Operation 32-A was similar and consisted in milling the underside of forward gunlock taper by raising the rear setting fixture plate to compensate for the angle. Average machining time, 1¾ hr. Operations 32-A and 40 were combined in a single operation at the Arsenal and the time given as 6.31 hours.



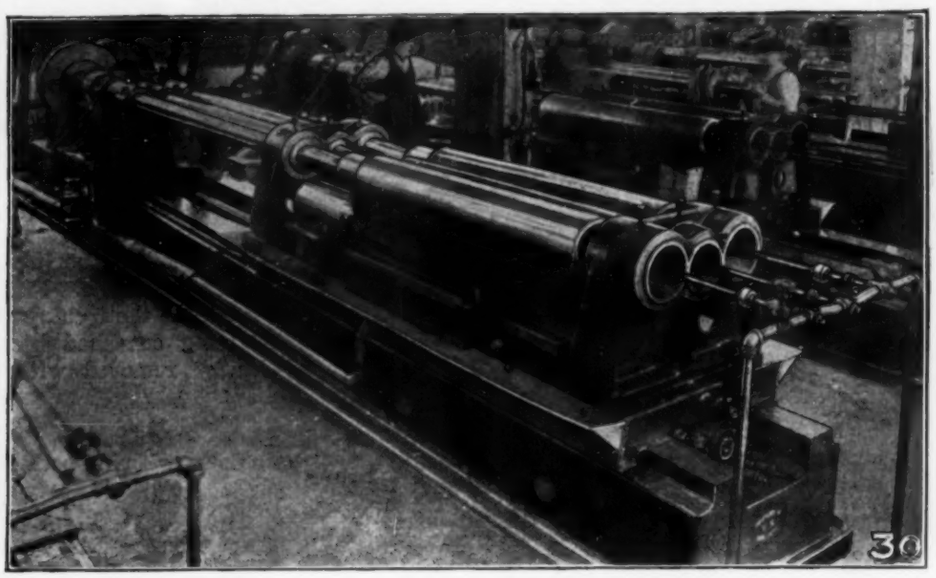


FIG. 29. USING AN UNUSUAL MILLING CUTTER. FIG. 30. REAMING THE CYLINDERS

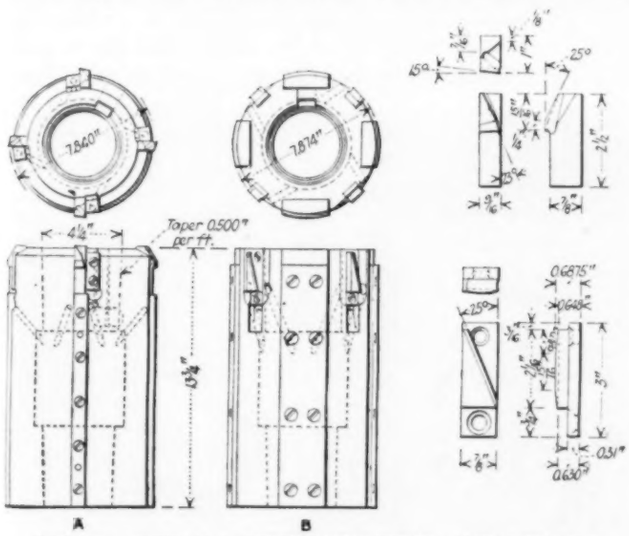


FIG. 31. DETAILS OF BORING HEAD AND REAMER

Finish-milling the breech end for the locking wedges and the several points which held the gun in place was probably the most important and difficult work to perform on the sleigh as it was impossible to protect against possible errors by any mechanical means, except by preparing the most suitable cutters and gages. Otherwise the workmen themselves had to be depended on and the great variation in the time was due principally to the need for training men to the extreme accuracy in workmanship which this particular part of sleigh required.

Operation 33

Finish-boring and reaming the three cylinders is shown in Fig. 30. Eight Otis type-9 triple bar boring mills were used in this operation. Revolution of boring bars, 5¼ per minute; peripheral speed of recoil cylinder reaming tools, 11 ft. per minute; peripheral speed of recuperator cylinder reaming tools, 9½ ft. per minute; table feed, 7½ in. per hour; average time on setting sleigh and finish-boring and reaming the three cylinders, 18¾ hr.; average low time on 10 sleighs, 16 hr. The time on this operation at the Arsenal was 20.11 hours.

A constant stream of cutting oil, mixture 10 parts mineral seal oil, four parts pale paraffin oil, one part

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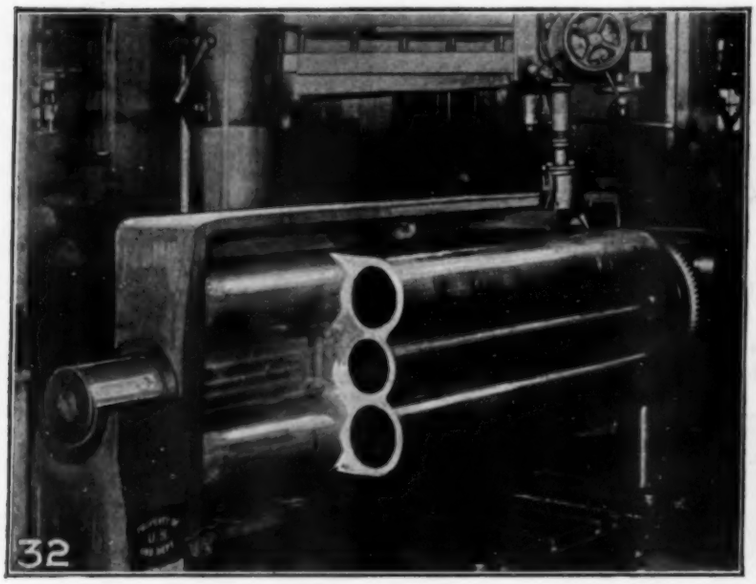
†General Works Manager, Otis Elevator Co.



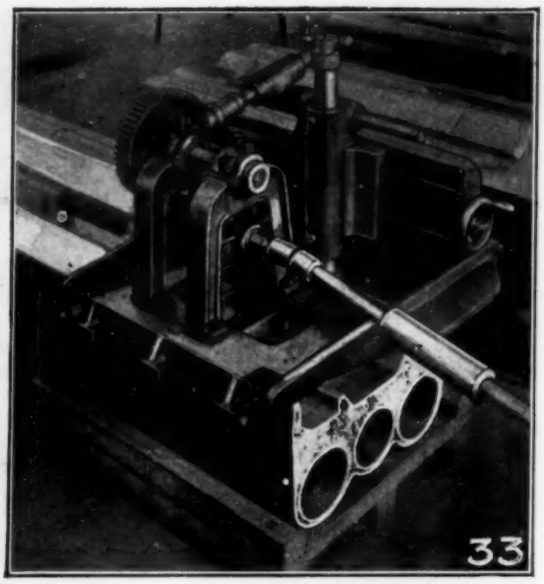


FIG. 32. TRUNNION FIXTURE FOR CROSS DRILLING. FIG. 33. A PORTABLE MILLING FIXTURE

lard oil concentrate was forced through the boring bar and heads directly into the path of the cutting tools. The finish boring heads *A* in Fig. 31, increased the diameter of the recoil cylinders from 7⅞ to 7.840 in. The boring heads were made of cast iron with semi-steel wearing strips that were readjusted by means of shims underneath and turned to correct diameter after each use. The cutters were ground to shape and the angle of the cutting tool fixed to insure the most reliable cutting edge that could be accurately maintained throughout the bore. After completing the finish boring cut the heads were replaced by the three finish-reaming cast-iron heads, *B* in Fig. 31, in which reaming cutters were inserted. After being inserted in the head the cutters were ground true with the bore in the head and each cutter was finally lapped by hand to a smooth cutting edge.

The heads were fitted with wearing strips of hard maple which were kept constantly in an oil bath and just previous to being used were turned to 0.002 in. larger diameter than the reamer. Each reaming cutter enlarged the cylinders approximately 0.030 in. Carbon steel was used in the finish-boring and reaming tools.

After a thorough study of boring mill design it was decided to make these triple bar machines with self-centering couplings between the driving mechanism and boring bars to prevent vibration. The triple stand at the driving end of the table was equipped with ground bushings in which the boring bars revolved.

The sleigh was set in place on hardened steel setting fixtures bolted and doweled to the table after being carefully located to insure the cylinders being bored parallel to the slide liner seats. When setting the sleigh, the table was drawn back so the taper ends of the boring bars extended through the triple stand at the end of the table; the boring heads were then put on the taper ends of the bars and the end nuts drawn up. Hardened and ground bushings were inserted in each bore of the triple stand and formed true and close fitting sleeves over the boring head wearing strips. The machine was then started, the triple stand with its sleeves guiding the heads in a direct line with the boring bars. The wearing strips on entering the finished bore directly behind the cutting tools, avoided sagging of the boring bars and prevented gouging by the cutting tools. Finally when the boring heads had completed their cuts and the same procedure with the reaming cuts had been accomplished, the sleigh was readily removed without interference of the boring bars.

Operation 34

Counterboring both ends of the recoil and recuperator cylinders preparatory to milling the internal threads in Operation 39. Two Otis type-9 boring mills with special boring heads fitted on the taper end of each bar were used. Average time on setting the sleigh and in machining the counterbore, 4¼ hr. Operations 34 and 39 were combined as a single operation at the Arsenal and the time given as 31.00 hours.

Operations 35 and 35-A

These operations consisted of drilling a number of small holes from each side of the sleigh into the breech pocket, preparatory to chipping out a rectangular sec-

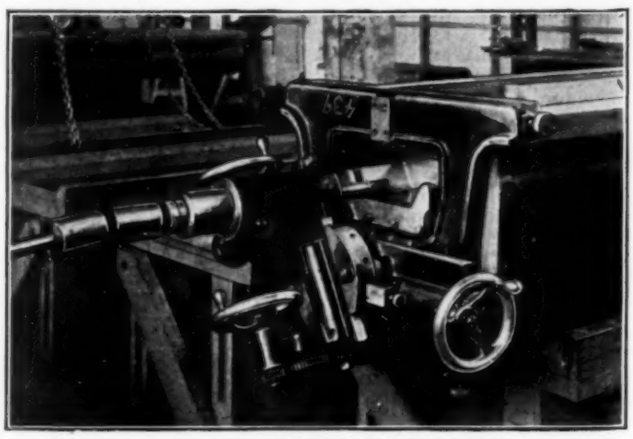


FIG. 34. ANOTHER PORTABLE OUTFIT

tion for slotter-tool clearance and for drains from the locking wedge pocket; also drilling and tapping both sides of the sleigh for locking wedge screws and filler plugs which are shown in Fig. 32. Four 5-ft. radial drilling machines were used. Average time on 280

sleighs combining both operations, 16 hr. Average time on 10 sleighs, on which the same work was done with more efficiency, 10¼ hr. Operations 35, 38 and 49 were combined in a single operation at the Arsenal and the time given as 18.30 hours.

The "turn-over" holding fixtures used in these operations made it possible for the operator to readily set the sleigh in any required position by means of the handwheel which actuates the balanced fixture through a worm and gear. Locking-pin holes which register the location for each hole to be drilled, held the fixture in place while the machine was at work. The fixtures which were equipped with holding bolts made it possible to readily change the sleigh from one machine to another, and in that way utilizing the best operators for the more important work.

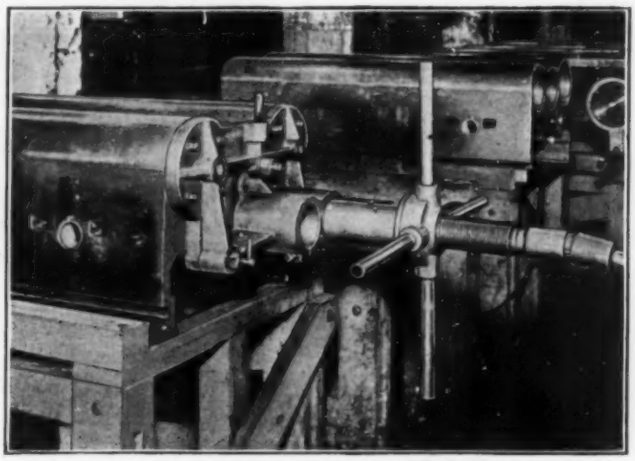


FIG. 35. A DRILLING AND TAPPING FIXTURE

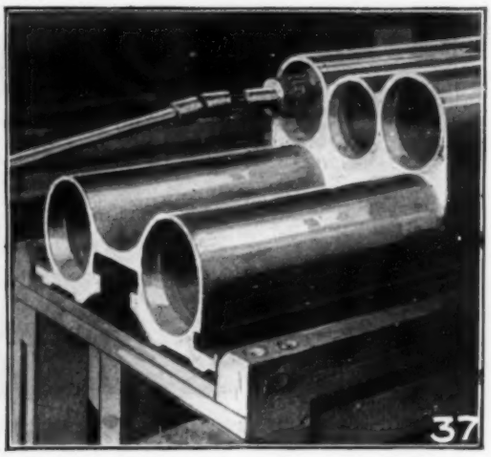
Operation 36

Planing four vertical recesses in the sides of the breech pocket into which the locking wedges are drawn when locking the gun in position and shown in Fig. 33.

Six portable slotting machines were designed and made for this operation; three right-hand for the work on one side, and three left-hand for the work on the other side of the breech pocket. The machines were quickly set in their correct positions by means of hardened setting plates fastened to them, the plates being pressed against the top and one side of the sleigh by means of handy clamps. The machines were driven by universal joint shafts from specially designed countershafts; the average time machining 280 sleighs was 29 hr.; average time machining 10 sleighs on which work was most efficiently done was 21½ hr. Arsenal time on this operation, 15.73 hours.

Operation 37

Profile-milling the irregular shaped bridge at the end of the breech pocket is shown in Fig. 34. Five portable milling machines were designed and made for this operation. Average time machining 280 sleighs was 8¾ hr. This work, with some minor changes, was reduced to 4½ hr. each on the last lot of 120 sleighs. The time on which work was most efficiently done was further reduced to 2½ hr. each. Arsenal time on this operation, 11.47 hr. The portable profile milling machines were quickly set in position on the end of the sleigh by means of hardened plates. Locating the machine in its exact relation to the work and with its hardened form plates for directing the milling cutter, proved to be a very safe and effective method for machining this portion of the sleigh. However all tools



FIGS. 36 AND 37. PORTABLE THREAD-MILLING DEVICES

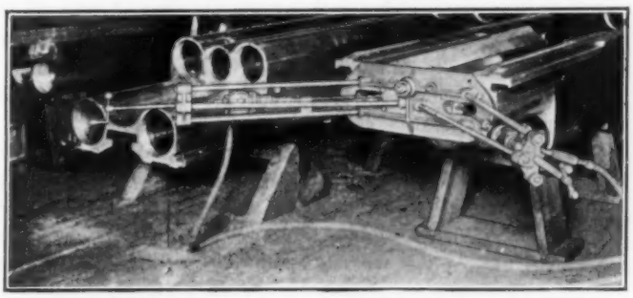


FIG. 38. AN ANGULAR DRILLING FIXTURE

Portable Tools

These portable tools, as in the case of others shown in following illustrations, were designed with the view of preventing spoilage by more or less inexperienced workmen and on account of the difficulty of securing deliveries on either standard or single purpose machine tools. Later developments proved that with a slight change in the design of recesses permitting the termination of a milling cutter, the recesses could have been milled in much less time by means of a portable milling machine designed to rest on the locking wedge seat. That such a machine was not made was due to reduction in the number of recuperators required.

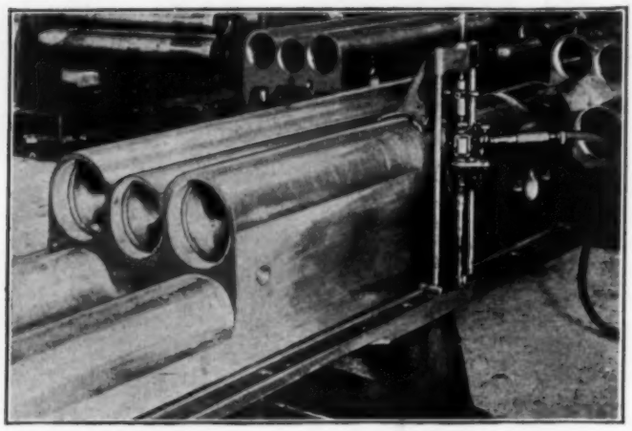


FIG. 39. A SPECIALIZED "OLD MAN"

that have no fixed feed, but are dependent on an operator's hand feed are subject to the whim of the operator and prove most efficient when a premium can be paid him for a full day's work.

OPERATION 38

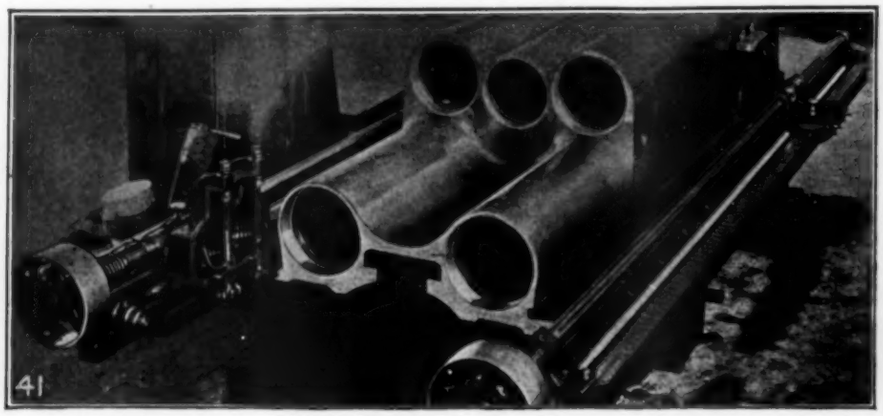
Drilling and tapping the hole for the wedge locking-bolt and drilling the drain hole in the rear of the breech pocket are shown in Fig. 35. Two portable drilling machines were designed and made for this operation. The base was clamped in a fixed position by hardened locating plates, the feed being by hand power. The machines were driven by universal-joint shafts from specially designed countershafts. Average time for setting the sleigh and machining 280 sleighs was 8 hr. Best average time on 10 sleighs was 6½ hr. Operations 35, 38 and 49 were combined in a single operation at the Arsenal and the time given as 18.30 hours.

OPERATION 39

Milling the threads in both ends of the recoil and recuperator cylinders is shown in Figs. 36 and 37. Five portable thread milling machines driven by universal joint shafts from specially designed countershafts were used. Average time in milling all cylinders in 280 recuperators was 12¾ hr. Best average time on ten was 8½ hr. Operations 34 and 39 were combined in one operation at the Arsenal and the time given as 31 hours.

The thread-milling heads were made with an outside expanding sleeve that was used for holding the head firmly in place in the cylinder. The inside of this sleeve has a lead screw corresponding to the pitch of the thread to be machined; inside of the sleeve is screwed the milling head with a corresponding thread on its periphery. Inside of the head is the driving shaft to the end of which the thread milling cutter is fastened, the bearings for this shaft being turned eccentric on the outside to permit feeding the cutter to the depth of the thread by means of a hand actuated feed screw. These milling heads proved very satisfactory, not only in their mechanical operation but also in the remarkable uniformity and smoothness of threads which were produced. The milling was done within 0.001 to 0.002 in. finished diameter and a hand sizing tap was used to bring the threads to exact size.

The benefit of using such a reliable device for machining these very important threads can be better realized by stating that in machining 1,680 threads only in one instance were the threads milled several thousandths large in diameter and this was caused by the day operator, who just before quitting changed a worn-out cutter and the night operator did not realize the machine had not been adjusted to the new cutter until two threads had been completed. Winter-strained lard oil was used on the threading hobs.



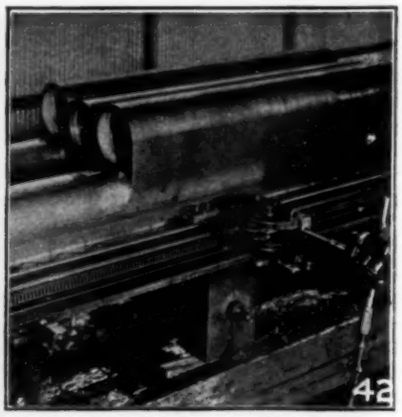


FIG. 41. A DOUBLE MILLING FIXTURE. FIG. 42. MILLING SINUOUS OIL GROOVES

OPERATION 40

Milling both edges of the forward gunlock to reverse angle on each side. Detrick & Harvey horizontal boring machine was used on this operation. Average time for this operation on 280 sleighs was 2 hr. Operations

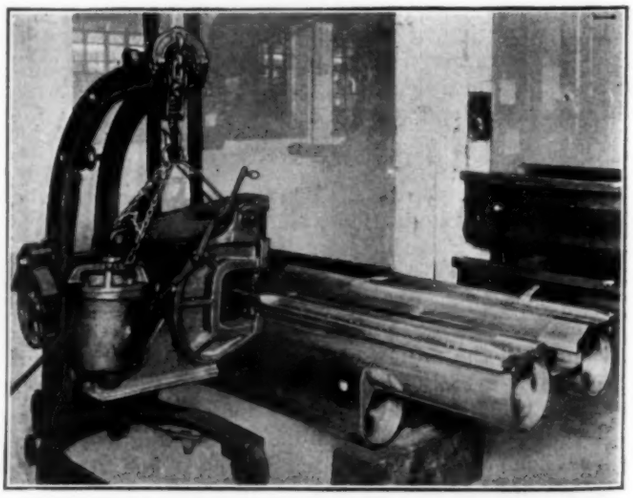


FIG. 40. RIVETING SLIDE LINERS

32-A and 40 were combined as a single operation at the Arsenal and the time given as 6.31 hr. The sleigh holding fixture was made to move on the machine table to the right and to the left, out of parallel with the cutter, the machine milling first one side with the sleigh set to the proper angle and then the other side after the fixture had been moved to the reverse angle. This opration was originally done with a hand broach.

OPERATION 41

Drilling two ⅜-in. holes commencing inside of each reservoir, both holes terminating at the same point about 8 in. from the end of the sleigh and is shown in Fig. 38. Four air drills with angle fixtures, were used. Average time on drilling holes in 240 sleighs was 1¼ hr. In the first lot of 40 the time was nearly 3 hr. each. Operations 41 and 47 were combined in a single operation at the Arsenal and the time given as 13.37 hr. The excess time on the earlier work was due to slow feeding of the drill, the workman being fearful of breaking the drills. Reducing the air pressure to a point where the machine would stop before breaking the drill, enabled the operator to proceed without fear. Operation 42 consisted in inserting the bronze slide liner. A 10-lb. sledge was used in this operation.

OPERATION 43

Drilling the rivet holes through the sleigh flange, using the holes in the liner for a templet is shown in Fig. 39. Four air drills and fixtures were used in this operation. Average time on 280 sleighs for operations 42 and 43 was 16 hr. Best average time on 10 sleighs was 10½ hr. No Arsenal time given on this operation.

OPERATION 44

Setting twenty-four ⅝-in. bronze rivets and ten ⅝-in. steel thrust rivets in the sleigh liner is shown in Fig. 40. One 8-in. reach, 8-in. gap Hannah Engineering Co. pneumatic squeezer was used in this operation. Average time on 280 sleighs was 7¾ hr. Best average time on 10 sleighs was 4 hr. Arsenal time on this operation, 19.53 hours.

OPERATION 45

Milling the bronze slide liner after it had been riveted into place in the sleigh is shown in Fig. 41. One special milling machine, was designed for this operation. Average time milling 280 sleighs, most of which required a roughing and finishing cut, was 4 hr. Arsenal time on this operation was 27.29 hr. On a number that had been previously rough planed, the finishing cut including the setting of the sleigh averaged 2¼ hr. The special milling machine was made to prevent spoilage which might more readily occur in a planing operation due to the difficulty of machining liners of this design. This milling machine proved to be a time saver and was less expensive than a planer. The design required that the slide liners be machined parallel with the cylinder bores and this was accomplished by setting the milling machine slides against the true machined edges of the sleighs as these surfaces and edges had been used in setting the sleighs on the hardened table-fixtures in all preceding operations. The location of the slide in relation to the side of the sleigh left insufficient space for a cutter arbor through which the cutter could be driven, so it was necessary to use the back of the cutter tooth for a gear tooth and the machine was designed so the driving pinion meshed into the cutter.

OPERATION 46

Milling oil grooves in both bronze sleigh liners is shown in Fig. 42. One special machine was designed and made for this purpose. Average time cutting oil grooves in 280 sleighs was 3 hr., operating one side at a time. Best average time on 10 sleighs was 1¾ hr. Arsenal time on this operation, 4 hr. The cutter head which was made in the shape of a cam, contained a small planer tool set into an adjustable toolholder. The head was moved along the slide of the machine which held a continuous rack into which the cutter-head driving pinion engaged. An air drill was attached to a worm that engaged a wheel attached to the driving pinion and in that manner the cutter head was moved along the slide. The toolholder was kept in motion by the revolving cam.

Why Not Put More Information in the Catalog?

BY GEORGE G. LITTLE

Getting the required information out of a catalog is sometimes like attempting to guess how many beans there are in a jar.

Wanting to order some machine chains the other day we looked up the kind and price and found that the cut showed No. 0 full size. As we wanted a larger size it was pure guesswork whether it would be No. 00 or No. 1, for the information given as to which way the sizes ranged, was entirely lacking.

In a machine catalog cuts are often shown giving some idea of the various attachments designed for special purposes, the descriptive matter merely stating that the method of manufacturing and assembling the attachments insure their being true and that there is no reason why they should not continue to remain true while in service when properly cared for. This is all good, interesting and valuable information to the purchaser, but there are those who would appreciate further information pertaining to the particular kind of work the attachment is designed for and similar work to which it would be adaptable.

Of course, it is understood that there are many persons fully acquainted with the attachments; but even so, attachments for machines are in a class with the carpenter's square—about one carpenter in a thousand knows anywhere near all the possibilities of the graduations on the square, while there are those who, could they get more detailed information out of the catalog, would see much more easily the adaptability of the attachment to their own requirements.

As an illustration, in a bench lathe catalog there are attachments illustrated that spell the story well enough perhaps for the initiated. But to the average lathe man doing small fine work, and the boss, superintendent or manager who is looking for a machine or an attachment that is easily adaptable to shorten the time on the work he is doing, a few words explaining one or more methods of using would help.

A bench lathe can be made adaptable to faceplate pattern work up to quite a large size, by fitting an extension quill driver that is long enough to allow the quill rest to be clamped at the end of the lathe bed and using a faceplate quill, the toolrest being secure at the proper height above the bench by blocking up.

Forge Shop and Other Railroad Shop Tools

Tools and Methods in Use in a Western Railroad Shop—Special Equipment to Utilize Air—A Unique Tap—Modern Method of Cleaning Castings

BY FRANK A. STANLEY

THE illustrations herewith represent some of the tools and methods used in connection with the work of the blacksmith shop and other departments in a railroad shop.

The halftone engraving, Fig. 1, illustrates a set of forging-machine dies for forming the ends of brake hangers. These hangers are later bent up to various lengths of arm and with different shapes of side arm, but the process of forming the ends, as illustrated by Fig. 1, is the same in the different designs. The sketch, Fig. 2, shows a typical hanger with straight bend for the side arms.

The sequence of operations as performed in the forging-machine dies (Fig. 1) is indicated by the numerical characters. In position No. 1 the bar of stock is upset and the metal driven up for the round head; position No. 2 forms the head round and flats

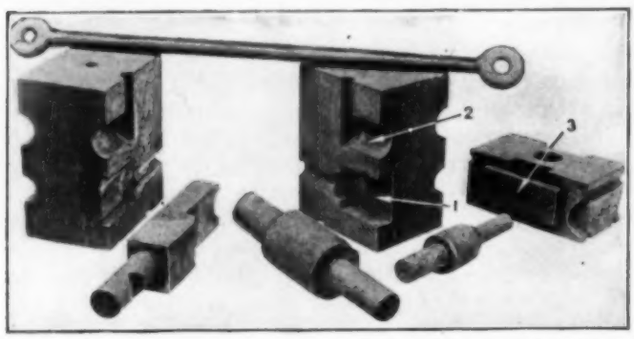


FIG. 1. DIE FOR FORMING ENDS OF BRAKE HANGERS

its sides smoothly and to the desired thickness; the next position No. 3, is the one in which the hole is pierced through the round ends. Then in a set of bending dies the straight bar is formed up to the U-shape shown in Fig. 2.

REINFORCING PLATE DIES

A set of bulldozer dies as used for forming up draft sill reinforcing plates for the construction of freight cars are shown in Fig. 3. These dies, which are of cast iron with straight forming edges from end to end, receive the flat plate and at one stroke form the channel-shaped member shown. A pile of the finished pieces is shown in the background.

The details in the drawing, Fig. 4, are of punch dies for holes ¾ in. square which are punched in tie plates.

The die block for this set of tools is shown at *A* and consists of a forged steel block finished 2 in. thick with a length of 7 in. and width of 5¾ in. This die block is seated in a holder or bolster *B* where it is secured by six setscrews, two placed at each side and one at each end. The center distance between die holes in the steel block *A* is 4 inches.

The dies are shown at *C*. These are finished 2¼ in. in diameter to fit the counterbored openings in the face of die block *A*. This counterbored seat is ⅛ in. deep allowing the die face to project ⅛ in. above the face of the block at the lower or inner side of the die, the opposite side of the die being cut angular to correspond to the angular surface under the tie plate. This is shown clearly in the detail section at *C*. The

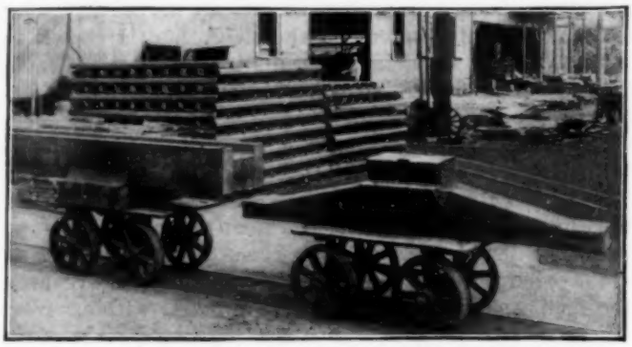


FIG. 3. DIES FOR DRAFT SILL REINFORCING PLATES

dies are locked in correct position in the block by a ⅛-in. pin *D* which fits in a hole drilled in the block in such a position that half the diameter of the hole is formed in the edge of the dies themselves. There is therefore no possibility of the dies becoming improperly located in their holder.

The punch holder, which is a steel forging, is shown at *E*. This holder is provided with rectangular seats at each side for the reception of the punches *F*, which are secured in position by clamps *G*. Each punch has an enlarged head, due to the offset for entering the punch holder openings and this head bears against a stop pin *H* which is fitted into the round hole *I* bored through the holder body.

In an earlier article reference was made to a convenient form of bolt rack for use in the forge shop and elsewhere where bolts are handled through various processes in large numbers. The view, Fig. 5, illustrates such a rack and shows its principle features clearly. As constructed here its frame consists of two flat sections of iron or steel bent edgewise to form uprights at the ends, the side members being connected

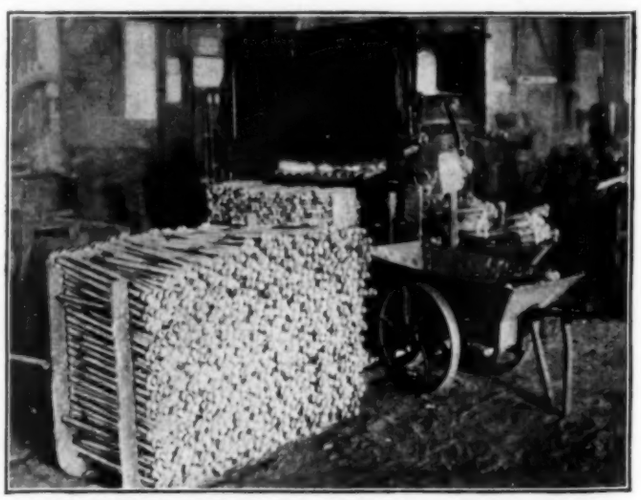


FIG. 5. BOLT RACK IN BLACKSMITH SHOP

by through bolts which pass through spacers made of pipe. With this construction, the rack can be made to any desired width of frame for different lengths of bolts simply by using holding bolts of necessary length.

Fixture for Grinding-in Dry Pipe

Some other appliances from other shop departments are illustrated in the engravings which follow herewith.

The halftone, Fig. 6, represents a convenient form of device for grinding-in the dry pipe in flue sheets. The method of setting up and operating will be apparent upon study of the illustration. The driving mechanism by which the work is operated back and forth in the grinding-in process consists of an air-motor mounted horizontally on a frame which is attached to the face of a steel plate bolted across the end of the boiler shell. Slots placed at different radii from the center allow the holding plate to be set at any position required to align the drive shaft closely enough with the work which is to be ground in.

The chuck or gripping head of the device for attaching to the pipe carries three setscrews which are adjusted outwardly from the center to force their pointed outer surfaces into the shell of the pipe and thus cause the pipe to be worked back and forth with the oscillation of the drive spindle. This spindle is connected with the chuck by a form of universal joint to provide the desired degree of flexibility in the operating mechanism. The outer portion of the spindle which passes through and is housed in the main carrying plate for the motor, is fitted with a slotted arm which is actuated to and fro by an eccentric and rod as indicated. The position of the connecting stud for the eccentric rod in the slotted arm determines the throw or stroke of the main shaft for oscillating the dry pipe.

The air hose leading up from the shop supply line to the pneumatic device on the boiler is seen at the right in the photograph.

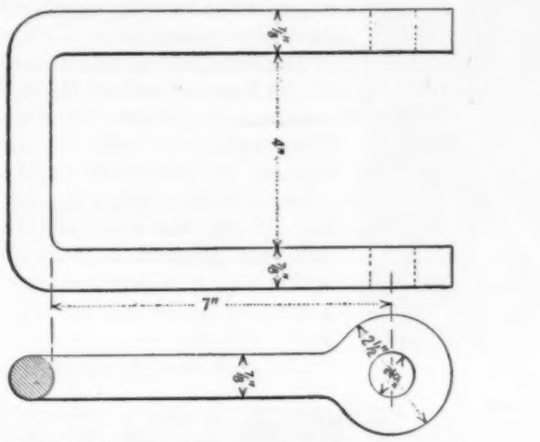
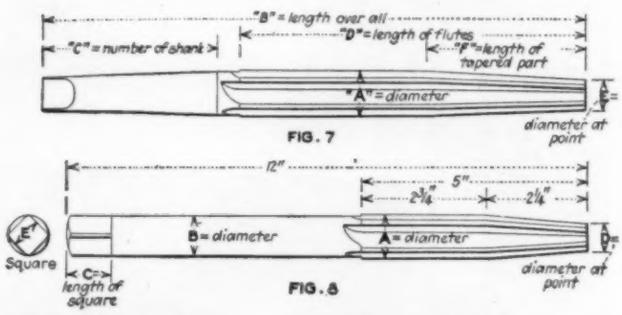


FIG. 2. BRAKE HANGER AFTER FORMING



Reamers for general work

A	B	C	D	E	F
¼"	G¼	N2	3/16"	5/32"	1⅛"
5/16"	G⅜	N2	3/16"	3/16"	1⅛"
⅜"	1⅛"	N2	4⅛"	7/32"	2"
7/16"	G½	N2	4⅛"	¼"	2"
½"	9"	N2	5⅛"	5/16"	2½"
9/16"	9"	N2	5⅛"	3/8"	2½"
⅝"	10"	N2	G⅝"	3/8"	2½"
11/16"	11"	N3	G⅝"	3/8"	3⅛"
¾"	12"	N3	7⅛"	7/16"	3⅛"
13/16"	12"	N3	7⅛"	½"	3⅛"
⅞"	12"	N3	7⅛"	9/16"	3⅛"
15/16"	12"	N3	7⅛"	5/8"	3⅛"
1"	12"	N3	7⅛"	11/16"	3⅛"
1⅛"	12"	N3	7⅛"	¾"	3⅛"
1¼"	12"	N3	7⅛"	13/16"	3⅛"
1⅜"	12"	N3	7⅛"	⅞"	3⅛"

Table for Fig. 7

Reamers for mud ring rivets

A	B	C	D	E
11/16"	1⅛"	3/8"	3/8"	1/2"
¾"	1⅛"	3/8"	7/16"	9/16"
13/16"	1⅛"	3/8"	½"	9/16"
⅞"	1⅛"	3/8"	½"	9/16"
15/16"	1⅛"	3/8"	9/16"	⅝"
1"	1⅛"	3/8"	9/16"	⅝"
1⅛"	1⅛"	3/8"	⅝"	11/16"
1¼"	1⅛"	3/8"	⅝"	¾"
1⅜"	1⅛"	3/8"	11/16"	¾"
1½"	1⅛"	3/8"	11/16"	13/16"
1⅝"	1⅛"	3/8"	¾"	13/16"
1¾"	1⅛"	3/8"	¾"	⅞"
1⅞"	1⅛"	3/8"	13/16"	⅞"
2"	1⅛"	3/8"	13/16"	15/16"

Table for Fig. 8

FIG. 7. REAMER FOR GENERAL WORK. FIG. 8. REAMER FOR MUD-RING RIVETS

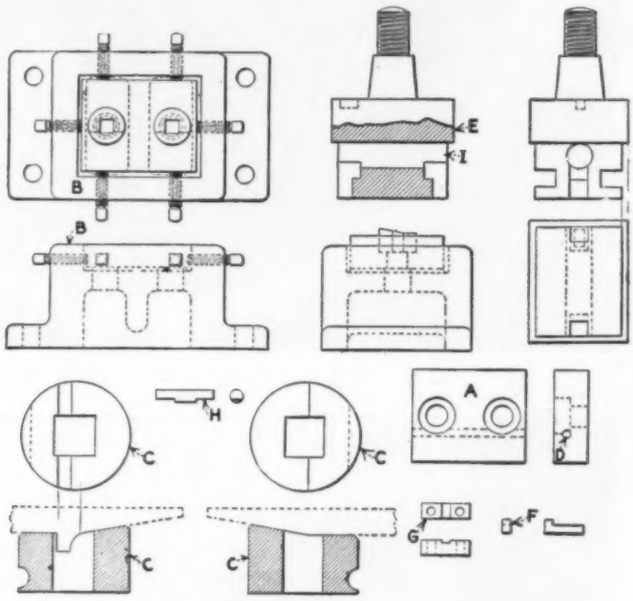
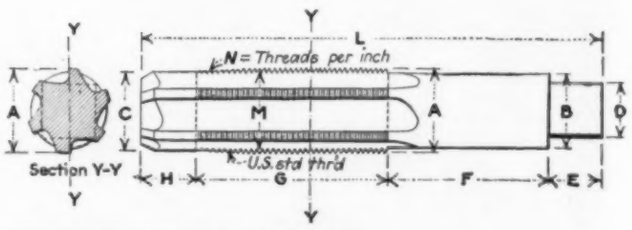


FIG. 4. ¾-IN. PUNCH DIES AND BLOCKS



A	N	L	B	C	D	E	F	G	H	M
2"	8	17"	1⅝"	1.783	1⅛"	1⅛"	G⅝"	7"	2"	1.837
2⅛"	8	17"	2"	2.033	1⅛"	1⅛"	G⅝"	7"	2"	2.087
2⅛"	8	17"	2⅛"	2.158	1⅛"	1⅛"	G⅝"	7"	2"	2.212
2⅛"	8	17"	2⅛"	2.283	1⅛"	1⅛"	G⅝"	7"	2"	2.337
2⅛"	10	17"	2⅛"	2.327	1⅛"	1⅛"	G⅝"	7"	2"	236
2⅛"	4	17"	2"	2.067	1⅛"	1⅛"	G⅝"	7"	2"	2.176
3"	8	17"	2⅝"	2.783	2"	2"	G"	7"	2"	2.837
3⅛"	8	17"	3⅛"	3.221	2⅛"	2⅛"	5⅝"	7"	2"	3.27
3⅛"	8	17"	3⅛"	3.471	2⅛"	2⅛"	5⅝"	7"	2"	3.525
3⅜"	8	17"	3⅛"	3.533	2⅛"	2⅛"	5⅝"	7"	2"	3.587

FIG. 9. MACHINE TAPS FOR BOLT SHOP

The drawings, Figs. 7 and 8, illustrate two styles of reamers, one for general shop work, the other for mud-ring rivets. Both are made with long tapered portions leading the straight size of the body. The tables accompanying the drawings give dimensions for all sizes from ¼-in. to 1⅜-in. reamers and for the mud-ring tools from 11/16-in. to 1⅜-in. reamers. The reamers for general work are shown as made up with tapered shanks for power operation, while the mud-ring reamers are for hand operation.

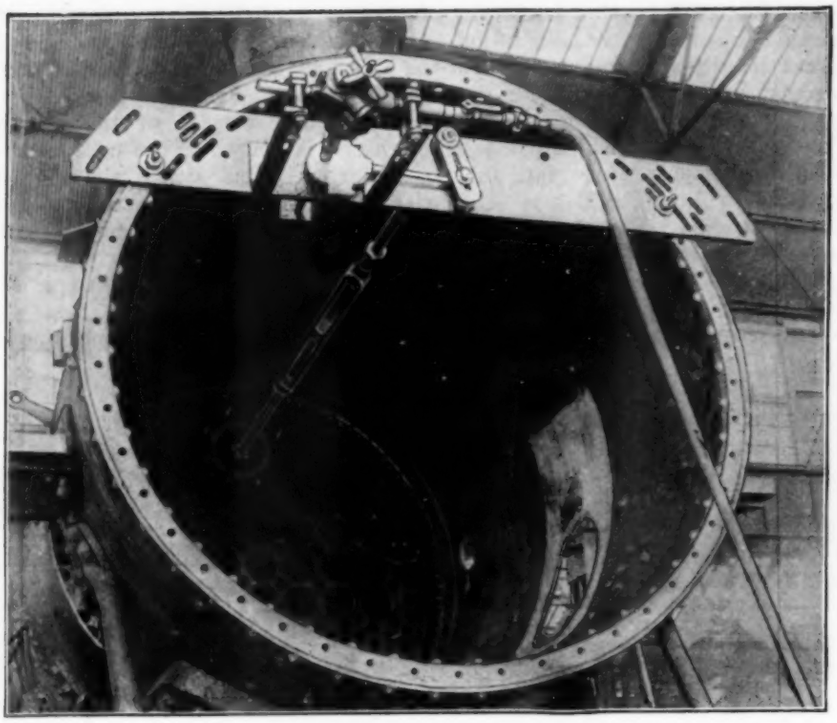


FIG. 6. APPARATUS FOR GRINDING-IN DRY PIPES

each tap has a reaming diameter 2 in. long preceding the threaded portion.

The halftone, Fig. 10, illustrates a method of threading large pipe flanges in the turret lathe. For this purpose a tap is used as a chaser, the tap being secured in a special holder on the carriage of the machine. One land of the tap is of course set on the center line of the work and each land eventually becomes a cutting edge as the others become worn.

The tools in Fig. 11 constitute a mandrel for turning cages or bushings for piston valves.

The tailstock carries a coned disk to fit the tapered end of the bore in the cage, and the headstock of the lathe is fitted with a head which is also slightly tapered to correspond to the tapered interior of the cage end. At the back end of the mandrel head there is a threaded portion as indicated, upon which a ring is mounted which acts as a nut and can be operated by means of a pin wrench.

The thin ring shown resting against

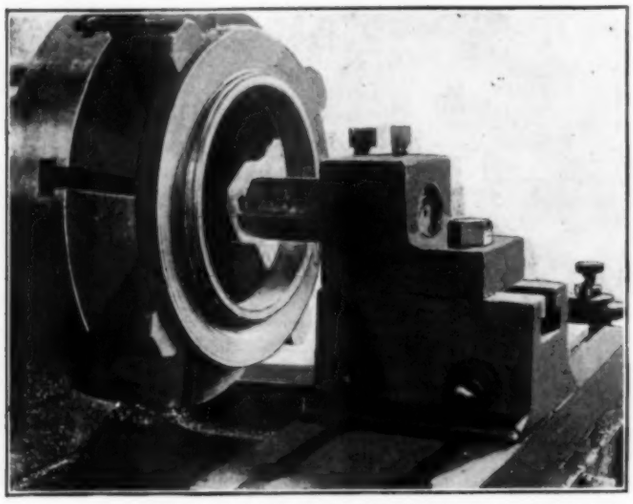


FIG. 10. A FLANGE THREADING TOOL.

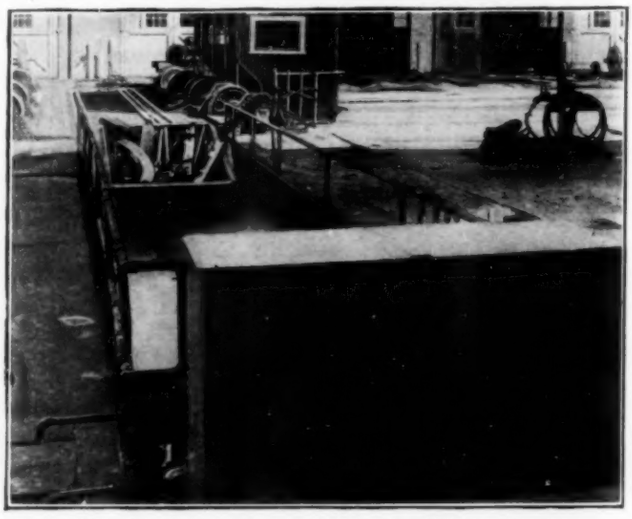


FIG. 12. CAR AND SODA PIT FOR CLEANING CASTINGS

In Fig. 9 a similar layout is reproduced for machine taps for use in the bolt shop. The range of sizes shown is from 2- to 3¾-in. taps. All taps are six fluted and

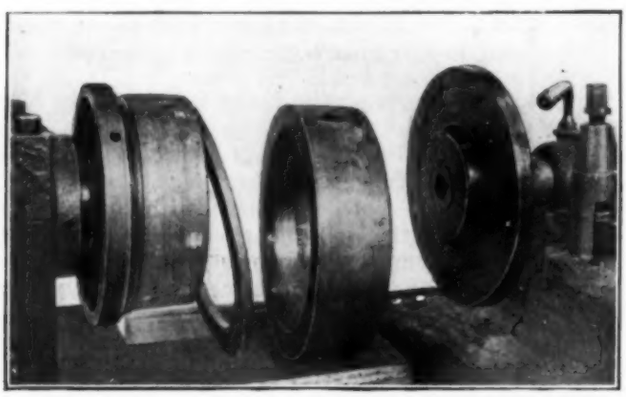


FIG. 11. VALVE-CAGE OR CHAMBER BUSHING MANDREL

the front end of the chuck serves as a backing off or spacing ring which is placed on the mandrel before the work is put into place. This spacing ring prevents the mandrel from being crowded too tightly into the work and when the ring nut is turned it acts against the thin spacing ring to force the work from the mandrel.

The large ring at the front in the photograph is used as an adaptor for carrying a larger size of valve bushing.

The final illustration in this article, Fig. 12, shows a soda cleaning pit used for cleansing all sorts of parts from engines and cars. These are placed in the special car shown which is then run down into the hot cleaning fluid where grease and dirt are removed from the work.

The tank is protected from all sides by heavy guard rails, as illustrated.

The methods and devices shown in this article are from the practice of the Southern Pacific Shops at Sacramento.

Ideas From Practical Men

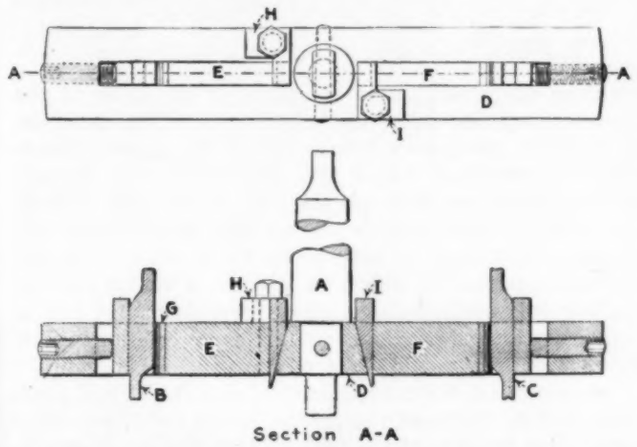
Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

An Adjustable Trepanning Tool

BY GEORGE H. BARKER

Having a large variety of different size holes to cut in armor plate, I designed and made the adjustable trepanning tool shown in the accompanying illustration.

The shank A was made from high-grade machine steel and case-hardened, a No. 4 Morse taper being used.



AN ADJUSTABLE TREPANNING TOOL AND ITS DETAILS

The tools *B* and *C* are of half-inch square self hardening high-speed steel. It will be noted that tool *C* presents a grooved cutting surface, while tool *B* has square ends.

The cutter bar *D* is fastened to the shank by a substantial taper pin and has slots ½ in. wide and 4¼ in. long in each end. The ends are left solid for ½ in. headless setscrews. Various lengths of blocks *E* and *F*, supplemented by small spacing strips *G*, give the main adjustments for various diameters. Fine adjustments are secured by the taper wedges *H* and *I* which are actuated by the screws shown.

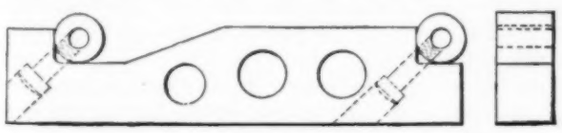
With this tool it was easy to cut any size hole desired from 3 to 10 in. in diameter.

A Handy Sine Bar

BY CLARENCE B. COE

Many toolmakers and machinists do not realize the value of a good sine bar for measuring tapers or angles on flat work, and in some cases on cylindrical work.

In the case of a taper wedge, where the dimensions given are the length and the size of the large and small ends, subtract the dimension of the small end from the large end, divide this by the length, and multiply by the distance between the rolls of the bar. The sine bar is used in the same way as a parallel but with one roll raised the above amount by the use of size blocks. This method will be found much quicker than to "cut and try" until the desired dimensions are secured.



A HANDY SINE BAR

If the taper is given in degrees, a table of the sines of angles will be necessary. All mechanical books have these tables. Find the sine of the given angle and multiply by the distance between the rolls on the sine bar.

The sine bar shown combines several features which will appeal to the man who uses one. It is neat in appearance, compact, easy to set up, and can be easily repaired if it should become inaccurate. The tendency to tip sideways, which is a fault common to others, is overcome by the rolls being directly under the center of the bar.

Most bars require the use of two sets of size blocks for setting, while this one needs but one set as one roll rests on the surface from which it is located.

The holes in the bar are to reduce the weight and for convenience in clamping the tool to an angle iron or other surface. These bars can be made any size, depending upon the nature of the work to be done. The writer finds that a bar with rolls 4 in. apart is the most convenient for the average work.

Turning Irregular Forms

BY J. DAVIES

Recently we had a considerable number of punches to be made to the form shown in Fig. 1. These were to be used for punching chain links. At the first

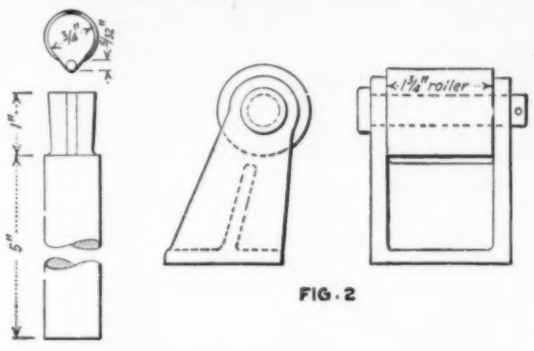


FIG. 1 FIG. 2

FIG. 1. THE PUNCH TO BE MADE. FIG. 2. THE ROLLER AND BRACKET

attempt we rough-turned one leaving enough stock on to get the shape; then marked off the profile on the end, milled as near as we could to the lines and filed the rest. This process was altogether too slow, so we did a little experimenting on the lathe with entirely satisfactory results.

Now I don't pretend to know the exact theoretical method of developing cams, but I will give an account

of our experiments and I think it will be agreed that we did the job properly.

First we dug out a casting from the scrap heap and

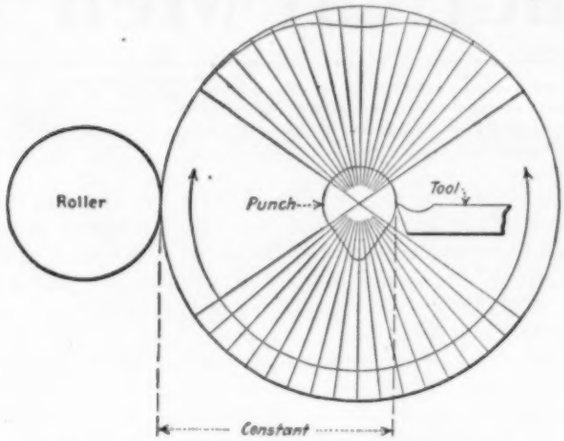


FIG. 3. METHOD OF LAYING OUT THE CAM

machined it to dimensions given in Fig. 2. Turned a roller to suit and then fitted the bracket on the back of the cross-slide so that the center of the roller was the exact height of the center of the lathe. Next we bored

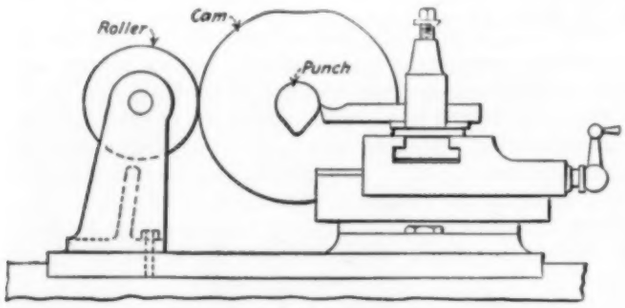


FIG. 4. ARRANGEMENT OF CAM, WORK AND ROLLER

out a piece of cast steel 4 in. in diameter and 1¼ in. wide a close push fit for the body of the punches to be turned. This piece of steel was to be used for a cam, and could have been any convenient diameter but it was thought the larger the diameter the easier the action, as the amount of throw remained constant irrespective of the size of the cam.

The next operation was to lay out the cam to produce the desired shape. This was done as shown in Fig. 3. The basic method used for laying out the cam was adopted, because as the roller was constantly pressed against the cam, and the bracket carrying the roller and the toolpost carrying the tool were both attached to the same slide, the distance between the tool and the roller would always be the same when measured in a straight line through the center of roller and the center of cam to the cutting edge of the tool. I said this distance was constant. I mean it was constant during the same cut. The feeding for depth of cut was done by using the compound rest. This shortened the distance at every cut and produced a different shape on the punch. So it remained for us to develop our cam to produce the right shape at the right size. This we did by marking off the cam as shown in the sketch, taking the distance from roller to tool as a constant when the tool was on the finishing cut and marking off a number of lines through the center of work and cam to the cutting edge of the tool. The number of lines is immaterial. The more lines the more points in the curve and consequently greater accuracy.

Next we took out the crossfeed screw and inserted

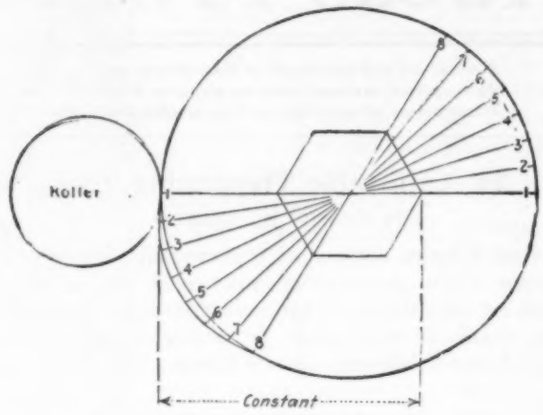


FIG. 5. CAM FOR TURNING A HEXAGON

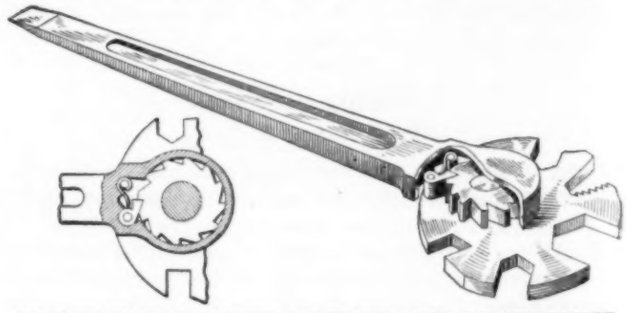
a strong spiral spring in its place at the back of the slide to keep the roller up to its work. The cam was fastened to the punch being turned by a ½-in. Bristo safety screw sunk below the surface, leaving enough stock sticking out through the end of the cam to form the punch. This gave us an entirely satisfactory job, the punches being finished perfectly to form and size. The arrangement is shown in Fig. 4. I venture to say that by this method any kind of irregular form can be accurately turned nearly as quickly as an ordinary round bar. This rig would be too expensive to produce a single piece but for repetition work I think it will prove very useful. We took the precaution to put taper dowel pins in the bracket at the back so that the whole attachment would be replaced on the lathe in about five minutes.

We have not yet tried to turn a hexagon but I believe it could be done and in Fig. 5 I have shown a sketch of the cam required.

Combination Ratchet Wrench and Screwdriver

BY C. F. GEORGE

The illustration shows a handy little tool that I have devised for working around automobiles, bicycles, etc., where there are many small nuts in places inconvenient



COMBINATION RATCHET WRENCH AND SCREWDRIVER

to get at with the ordinary form of wrench. Openings in the disk may be provided for various sizes of nuts as required.

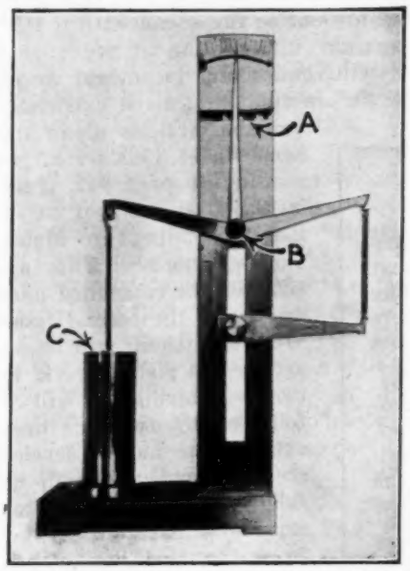
With the disk turned so that the smooth portion is uppermost, it makes a convenient handle for the screwdriver.

An Efficient Spring Tension Tester

BY G. E. BULLOCK

The accompanying photograph is that of a spring tension testing device which was developed in our plant for our own use, and which we feel is quite superior to anything for the purpose that we have seen yet. The device consists of a vertical standard on a substantial base, and a pointer which is made with an arm projecting on either side. The pointer is fastened to the column at *B*, the pin which holds it running through an agate bearing so as to render the device as sensitive as possible. The standard is constructed with a T-slot at *A* to accommodate adjustable pointer stops which give and maintain a positive inspection limit. The stops are adjusted to the limits allowed on the various springs.

The arm which is shown holding the lower end of the spring is adjustable vertically to accommodate the different sizes of springs. The upper end of the spring is attached to one arm, while to the other a weight is suspended as shown at *C*. The proper location for the arm and the exact size of the weight have been calculated for each size of spring, so that if the tension of the spring is perfect, the pointer will rest at center as shown. If the pointer rests against either of the stops, the tension is not within the specified limits and the spring is rejected.



A SPRING TENSION TESTING DEVICE

Master springs are not necessary as the weights interpret the condition of each spring, thus enabling the standards to be maintained.

Grinding Flats on Cylindrical Work

BY ALBERT L. EDDY

We had a quantity of pieces to make, similar to the ones shown in Fig. 1. The two flats at *A* and *B* were ground on a rotary surface grinding machine which, together with the holding fixture is shown in Fig. 2.

The fixture has taper holes in the periphery to hold the shanks of the pieces and is provided with a pilot for locating it on the magnetic chuck of the machine. The pieces were seated in the fixture by tapping lightly with a hammer, no screws or clamps for holding them being necessary. After the flats on one side of the work were ground, the fixture was turned over for grinding those on the opposite side.

The accuracy of the work was checked up by the dial indicator shown at the left in Fig. 2. With 0.093 in. of stock to be removed the production was 150 per hour.

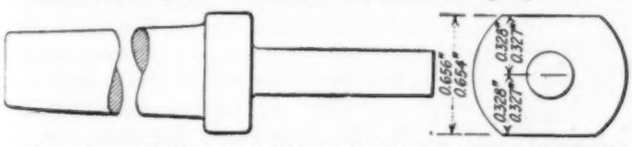


FIG. 1. THE WORK ON WHICH FLATS ARE TO BE GROUND

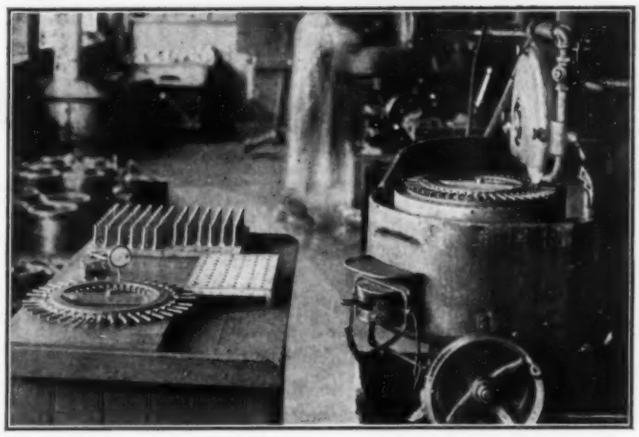


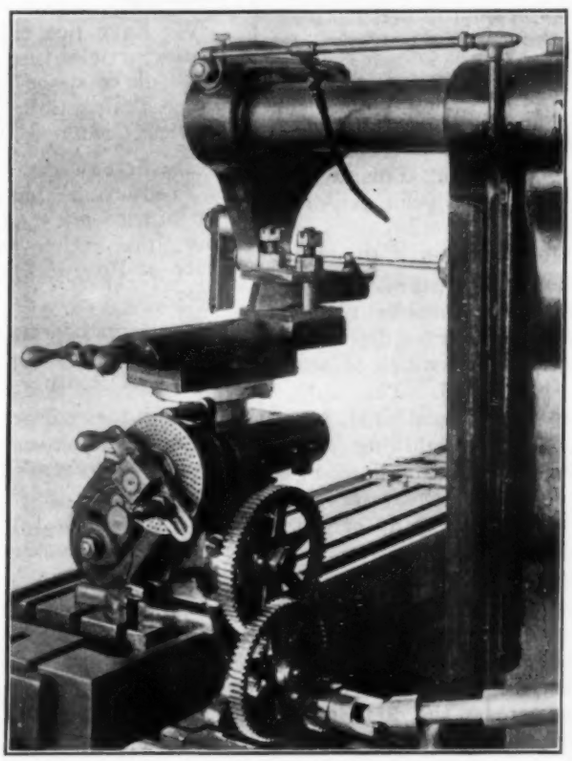
FIG. 2. MACHINE AND FIXTURE FOR GRINDING THE FLATS

Radius Turning on a Milling Machine

BY H. W. BOULTON

Herewith is an illustration of a radius-turning set-up on a Milwaukee milling machine which I think may be of interest to the readers of the *American Machinist*.

The work to be machined was a rod 0.4 in. in diameter, 12½ in. long, in the center of which a radius of 9¾ in. was to be turned to a depth of 0.053 in. The dividing head of the machine was fitted with an adapter to which the compound rest of a lathe was attached. The feed was obtained through gears driven by the telescopic shafts as shown. The work was held in a draw-in chuck and supported by a center backed up with a spiral spring.



SET UP FOR RADIUS TURNING ON A MILLING MACHINE

IN THIS ISSUE

WE ARE trying very hard to get to you the many good things that we have gotten together. Our magazine isn't small but when we get right down to getting the articles in we feel somewhat limited in space. Something quite frequently has to be held over for a later issue. This week it is "Tool Engineering." We were all set with the nineteenth of the series, a seven-and-a-half page article dealing with the design of broaching and broaching fixtures, but found it necessary to postpone it until next week. Even then we shall be able to publish only half in one issue. It will be concluded the following week.

Among the good things that we did get in this week is the leading article, "Making an Optical Flat," by R. W. Porter of the Jones & Lamson Machine Company. In the fall of 1920 we published articles explaining the use of optical flats. Their use is becoming more general so that the present article which explains the making of the flats is not out of place.

On page 332 is the second of Prof. McCabe's articles on the economics of production. This week he takes up changes in demand.

We complete Chubb's series on machining the Wrigley automobile transmission gear with this week's article which begins on page 333. The sub-operations considered are those on machining the gear frame and axle parts, assembling a gear frame and the checking up of the various parts.

E. W. Leach has now reached a most interesting point in his advice on the organization and management of the small shop, namely, financing the company. How to get the money to organize and carry on his business may not be the first thing that a prospective small business man thinks about, but it is not very far from it. If he cannot interest capital he may as well forget about his project. Hard as it is to get capital he must be careful in his selection of the men who will supply the money for his business. "I am sorry," says Mr. Leach, "that it is not possible for you to know me personally so that you could not fail to appreciate the sincerity with which I advise you to exercise every possible caution and discretion in seeking the capital for your business." And, "capital is a peculiar commodity, earned only through hard work and parted with only under pressure or under promise of multiplication through investment. It possesses real potential energy, the power to do things; but it is possible of strange manipulations, and can easily be the basis of misunderstandings which can seriously interfere with the progress of a business organization." This extremely interesting and very true article begins on page 338.

The preparation of our series on motor service work is progressing, but we are not so far ahead with it that we feel protected against interruption if we should start publication. It will come along in several weeks and in the meantime we are supplying some extremely valuable articles along the same lines. This week, beginning on page 342, there is the first part of "Cylinder Grinding in Motor Repair Shops." This article will be concluded next week. In the second issue after that there will be an article on piston work in motor repairing. It will be followed by two or three articles on motor service stations, and they will be followed by the motor service articles proper.

Another series is finished this week, namely, "Incentive or Production Basis of Wage Payment," by Henry H. Farquhar. The current article begins on page 344. The series has been short, the articles have been right to the point, and many good things have been said. On the whole, it leaves a good taste. This week's article takes up the assignment and recording of production, co-operation with the workman, fitting the system to conditions, securing the co-operation of executives, and methods of reward.

The fourth of the articles by Col. Jenks and M. H. Christopherson relative to manufacturing with special machines vs. standard equipment, page 349, describes portable devices for plain and thread milling, an angular drilling fixture and a special machine for milling sinuous oil grooves.

A short railroad article by Stanley, page 354, takes up forge shop and other railroad shop tools. The tools and methods described are in use in a western railroad shop. They include special equipment to utilize air, a modern method of cleaning castings and some unusual fixtures. The apparatus for gringing-in dry pipes is of particular interest.

Coming Features

"Tools for Manufacturing a Musical Instrument" will be one of the complete articles next week. An ordinary mouth harp doesn't look like a difficult manufacturing proposition yet there are some surprising problems provided in its make-up.

We have not exhausted the supply of automotive articles that Colvin has been working up, but lack of space has made it necessary to advance their publication dates. Machining the Peerless Crankcase will be run next week.

The first two articles of McCabe's "Economics of Production" have given a good indication of the nature and value of this economics series. The third article, with the sub-title "Cost and Price of Production," is scheduled for the next issue.

The conclusion of the first motor service article (on cylinder grinding) will appear, and there will be other complete articles.

We hope to get in the last of Sheldon's magnetic chuck series which has been postponed from week to week for a long time.

Then there will be the fourteenth article on metal cutting tools and the nineteenth on tool engineering.

EDITORIALS

Abuse of Free Service

SOMEBODY has to pay for what is commonly called "Free Service." Nothing is free that is in the least worth having in this world we live in, but it is very hard to convince some people of this important fact. It seems to be human nature to try to get something for nothing. Some few may succeed in so doing but it is always at the expense of somebody else and in the long run everybody pays in one way or another.

The machine tool business is no exception to the general rule. There will always be some incompetent or unscrupulous purchasers who will play upon the manufacturer's fear of his competitors to exact free service from his field men in cases where the purchaser himself is solely at fault. It is comparatively easy for a man who knows the game to put the manufacturer in a position where it takes considerable backbone to do the right thing.

The motor truck industry has faced a very similar problem in the question of free demonstrations. At one time it was possible by playing the various agents against each other to secure an amount of free hauling that came to a sizable figure in the aggregate. A flat daily charge in proportion to the capacity of the truck, which was credited if the prospect placed his order, had the desired effect.

Charges for repair and adjustment service are made by the typewriter companies and paid without question by the typewriter users. Why should machine tool service be treated any differently?

Service in the passenger car field has also been referred to by men seeking machine tool service of the free variety. As a matter of fact, it seldom consisted of more than the replacement of defective parts, the customer having to stand the labor charge for tearing down and reassembling. Any other service has been charged to the car owner at regular rates.

The trouble in the machine tool field is largely due to purchasers who do not employ first-class mechanics to look after their equipment. Complicated tools are bound to suffer from the maltreatment of incompetent operators. Immediately there is a call on the builder to send a service man to correct the trouble and there is always strenuous objection to paying for the work.

What is the result? To protect himself the builder must add enough to his selling price to cover the cost of unnecessary free service. The buyer who doesn't use it pays for it just the same and thus helps to keep his competitor going. Efficiency is penalized.

If the other fellow were unable to get away with his demands for free service there would be no excuse for the inclusion of such an overhead charge in the price of the machine tool and competition would soon squeeze this water out of the selling price sponge.

The engineers' committee on the elimination of waste could well spend some time in investigating the amount lost to the community by this much-abused practice. We can ill afford to waste time, money and technical skill in bolstering up the weak brethren in our commercial struggle, particularly where their weakness is caused by unfair demands upon others who are not strong enough to resist them.

Machine tool service should be charged and paid for just as any other service is charged and paid for. When it is, it will be possible to reduce the cost of machine tools by the amount of overhead occasioned by the service charge, and both builder and seller will benefit.

The Cost of Handling Material

NO MATTER how many other problems present themselves at this time, we must never lose sight of the fact that the problem of economical production is always with us. And it is bound to be with us more and more as the days go by. For the huge war debts which we all must pay mean that we must be able to make our purchasing dollars go further than ever.

Economical production must be more than a by-word, it must be a reality. There are few shops where production costs cannot be decreased in various ways, and this without decreasing wages materially, if at all. For it is not what a man gets per day but what he produces for a dollar, which tells the story. It is not nearly so important to reduce the total wage as to make each wage dollar mean more in finished product.

There are many lines which can be studied to advantage in reducing production costs. One which is frequently overlooked is that of shop transport of materials. This begins with the delivery of the raw material and ends only when the finished machine has been delivered to the railroad.

This question of transportation includes overhead traveling cranes of various spans and hoisting capacity, jib and wall cranes, post cranes, air, electric and hand hoists, electric shop trucks, hand trucks, portable platforms and tote boxes.

It will pay to study them all carefully. Have we cranes enough to cover the length of the shop without undue loss of time? Are the cranes delaying workmen and holding expensive machines idle? Are we using our 10-ton crane where the electric shop truck should be used—or vice versa? Do we handle work too often and take too much time? Are there enough jib or post cranes to supplement the traveling cranes?

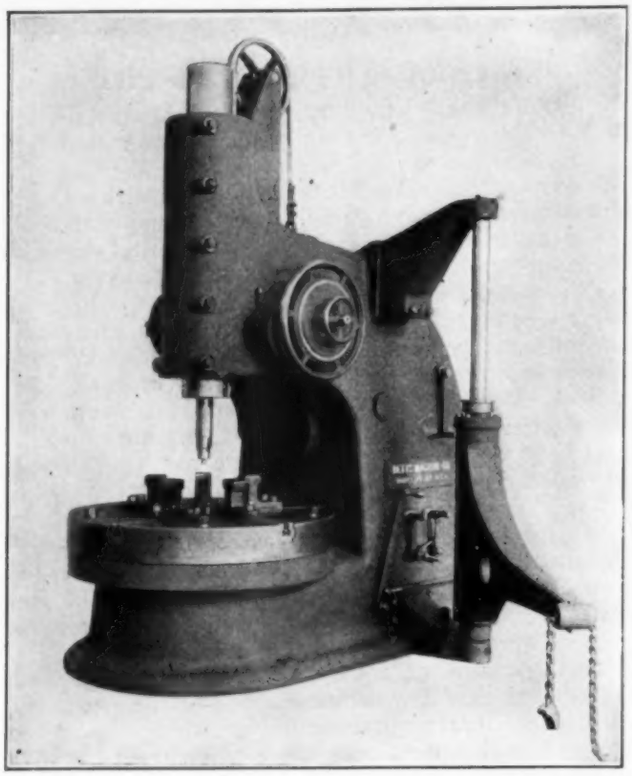
These are but a few of the questions to be asked. But before we have gone far we will see that not only the problems of cranes and transport, but the problems of routing are involved as well. There are few shops where the routing cannot be changed to eliminate considerable lost motion.

If the shop is of the multi-storied type, the question becomes more difficult and here the elevators play a most important part. Study them carefully, in connection with the method of carrying the material from floor to floor, and many economies can be effected. Make the elevators large enough and powerful enough to carry shop motor trucks and efficient loads. Better shop transport presents means of securing more economical production.

Shop Equipment News

Betts Car Wheel Boring Machine

The 52-in. car wheel boring machine illustrated is the latest addition to the line of heavy railroad tools manufactured by the Betts Machine Co., Rochester, N. Y. It was designed and constructed as a rapid production machine to cover the range of requirements of both car building and railroad repair shop work.



BETTS CAR WHEEL BORING MACHINE

Great care was taken to insure proper and adequate lubrication for all revolving parts.

The bed and frame were made in one casting to secure rigidity. The table is proportionately heavy, revolves on a wide bearing and has a large spindle running in bronze bushed bearings. The spindle is provided with a locking collar on the lower end.

The boring ram is of large diameter and has a long bearing in the frame. It has hand adjustment, which is facilitated by a counterweight. When desired, the machine can be equipped with a facing ram, so constructed that the facing head is supported close to the cut to enable very heavy cuts to be taken. It can be slid back out of the way when chucking wheels.

The table is equipped with a five-jaw combination chuck that is built into the table. It can be readily adjusted for wheels of any size. Five operating stations are provided for convenience.

Six boring and facing feeds are obtained by means of a two-step cone and hardened sliding gears so arranged that change from roughing to finishing speed can be made instantly.

Ease of control is one of the features of the machine. All levers are within easy reach of the operator. The long lever shown at the right of the table is used for operating the friction clutch and brake for starting and stopping. The two short levers shown at the right of the long lever are for obtaining the speed changes. No two sets of gears can be in mesh at the same time..

The machine drive may be through single pulley or by direct connected motor, either constant or variable speed.

The regular equipment includes a quick acting air operated crane for handling wheels. The crane can be furnished to be operated by individual motor or by belt.

Velco No. 4 High-Speed Broaching Machine

The Velco Manufacturing Co., Inc., of Greenfield, Mass., has recently placed on the market the heavy-duty broaching machine shown in the accompanying illustration. The machine is said to be very rapid in operation, making the cutting stroke at a speed of 15 ft. per min. and the return at 55 ft per min. The manufacturer claims not only a gain in production, but that the work produced is superior to that done at a slower speed.

The broach holder is attached to a solid steel head, supported by bronze gibbed bearings sliding on steel ways. The driving rack meshes with a hardened steel pinion cut from the solid on a heavy shaft having long bearings at either side of the pinion, stub teeth being used. The broach is attached to the rack so that the pull comes directly on the rack pitch line. All vertical adjustments are made at the face plate. The teeth of the rack are on the under side and the sides of the rack are guarded, protecting the operator from injury. All moving parts except the rack are completely inclosed. The rack is supported and held in proper mesh with the driving pinion by means of rollers placed on the sides of the pinion and by guide bars fastened to the sides of the rack.

The pinion shaft is driven by a phosphor-bronze worm wheel and a hardened steel worm, running in oil. The worm shaft is provided with ball thrust and radial bearings, and all other important bearings are bronze bushed and ring oiled. The rapid return is accomplished by an internal gear cut on the worm wheel and driving the return gear shaft. The return motion is applied through the driving pinion and there are no high speed gears, the fastest gear speed used being a surface speed of 60 ft. per minute. The clutch is not operated during the cutting stroke, and acts as a positive coupling. There are no friction clutches employed.

In operation, the belt is first shifted to the loose pulley, thus relieving the load from the clutches, when a further movement of the shifting lever applies a friction brake to the driving pulley and withdraws the positive clutch. A still further movement of the same lever engages the reverse clutch, and then shifts the driving belt onto the tight pulley, thus reversing the machine.

The automatic stops are quickly adjustable and positive in action, non-removable emergency stops being

VELCO NO. 4 BROACHING MACHINE

provided to protect the mechanism. Centralized control is provided, a single lever regulating every motion of the machine. The direction in which the operating lever is moved indicates the direction in which the rack will travel. No countershaft is provided and the machine has one speed only, as it is designed to deliver its maximum effort at the high speed. The manufacturers contend that there is no necessity for operating the broaches at a slower speed, and that speed changes in machines of this type are usually provided to increase leverage, rather than to provide an efficient cutting speed for the broach.

The bed of the machine is of box section, strongly reinforced. It is supported at the front and back by cabinet bases, the front cabinet forming a storage space for the smaller equipment. All adjustments are simple, it is said, and the entire mechanism is easily accessible. Cooling fluid is supplied by a gear-driven pump of large capacity, and a pan telescoping into the bed catches the chips and returns the fluid to the reservoir.

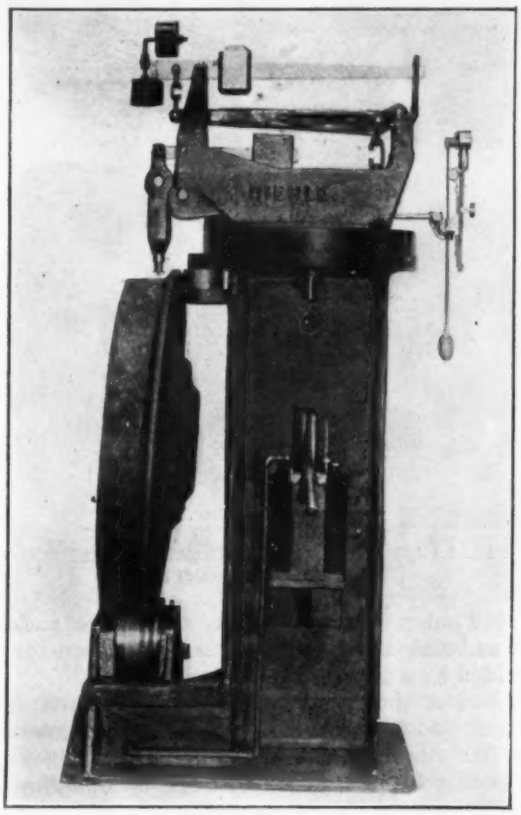
The maximum pulling effort requires 15 hp., although all ordinary broaching operations may be handled with a 10-hp. motor. The machine is furnished with either belt or motor drive, there being no change in construction necessary for either style.

Riehle Combination Brinell and Scleroscope Hardness Testing Machine

The accompanying illustration is that of a combination Brinell and scleroscope hardness-testing machine which has been developed by the Riehlé Bros. Testing Machine Co., Philadelphia, Pa., for testing the hardness of chilled car wheels. The machine was designed primarily to assist the Association of Manufacturers of Chilled Car Wheels in making a study of the hardness of chilled wheels as compared to their wearing and breaking qualities. Incidentally the value of the hardness test as an indication of the general serviceability of the chilled iron wheel will also be determined.

The machine makes it possible to employ both the Brinell and scleroscope methods on the same spot. The method of registering the Brinell load is the Riehlé lever and beam system. At the rear of the machine is the Shore scleroscope. The scleroscope and Brinell weighing systems are both carried by the same housing, which is bolted to a turn table so that the whole upper part of the machine can be revolved with the Brinell ball and scleroscope dart in the circumference of the same circle.

To test a wheel, the turn table is revolved 90 deg. from the position shown and a car wheel rolled into place resting on the two ground rollers. An inclined track makes it possible to push a wheel into place. The turn table is now revolved until the scleroscope comes over the wheel. When the center position is reached the turn table locks automatically. The scleroscope is now lowered and a test is made. Then the turn table is revolved 180 deg., which brings the ball into position for the Brinell test. The rollers supporting the wheel rest on a hydraulic plunger and a few strokes of the hand pump shown raise the wheel against the ball. When the wheel touches the ball an initial reading of the depth indicating device is taken. A few more strokes of the hand pump put on the full Brinell pressure, which is indicated by the beam rising in the gate. A by-pass valve is opened, the wheel lowers slightly, a



RIEHLÉ COMBINATION BRINELL AND SCLERESCOPE HARDNESS TESTING MACHINE

stroke or two of the hand pump again puts the wheel in contact with the ball and another reading of the depth device is taken. The difference between this and the first reading gives the actual depth of impression.

The by-pass is again opened, the wheel is lowered and is then turned into a new position. This is repeated as many times as it is desired to make tests around the wheel.

The depth indicating device, for measuring the Brinell impression, is entirely new in design and rests in the Brinell head directly over the ball. There are three specially shaped fingers, two of which rest on the tread of the wheel while the third finger rests on the ball. By this method the relative motion of the wheel and the ball is registered without any intervening mechanism which might tend to introduce errors. By eliminating these, extremely accurate depth readings are easily obtained. Such a combination as this makes possible the more extended use of hardness tests in many other lines.

Production Machine Co. Type R Utility Grinding and Polishing Machine

The machine shown in the illustration herewith has recently been brought out by the Production Machine Co., Greenfield, Mass., and is a combination of several types.

The base and head are in one casting, providing a rigid support for the spindle and bearings. The spindle

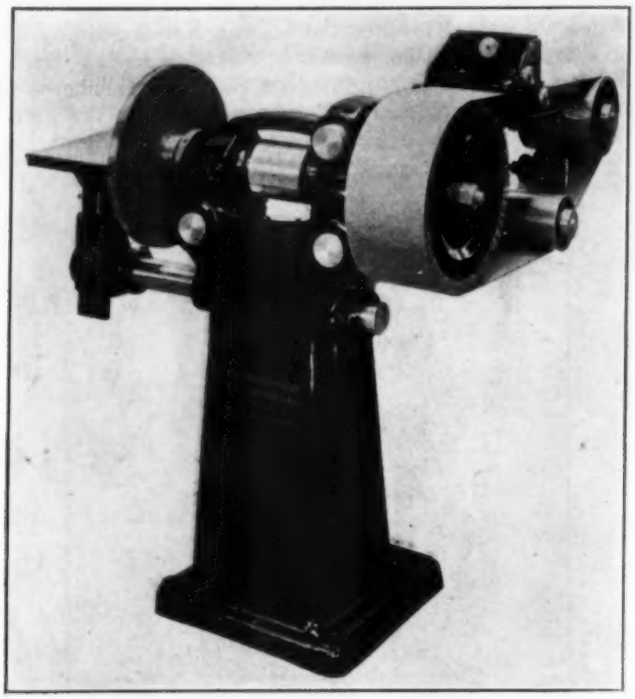


FIG. 1. UTILITY GRINDING AND POLISHING MACHINE (FRONT)

runs in Timken roller bearings, which are packed in grease and sealed to exclude dust. Adjustment for wear is provided by a threaded sleeve and nut.

One end of the spindle is furnished with a double-faced disk and the other with a leather cushioned wheel over which runs a 6-in. endless abrasive belt. A quick adjustment for tracking the belt and an idler for keeping it tight are provided. At the rear of the machine is a table for surfacing work on the belt. The table is provided with an adjustable gage arranged for handling articles with straight or beveled edges and so attached that it may be quickly swung out of the way for changing abrasive belts. The table for disk grinding has both vertical and circular adjustments and is provided with a rocking seat to accommodate beveled work.

Specifications: Diameter of disk wheel, 15 in. Table for disk wheel, 9½ in. Cushion wheel; 14 in. diameter, 6 in. wide. Abrasive belt, 6 in. x 7 ft. Surfacing table for belt, 6½ x 14 in. Driving pulley, 4½ x 4½ in. Spindle speed, 1,300 r.p.m. Abrasive belt speed, 4,764 ft. per minute. Hp. required, 3. Floor space, 36 x 37½ in.

T. C. M. Semi-Automatic Axle Machine

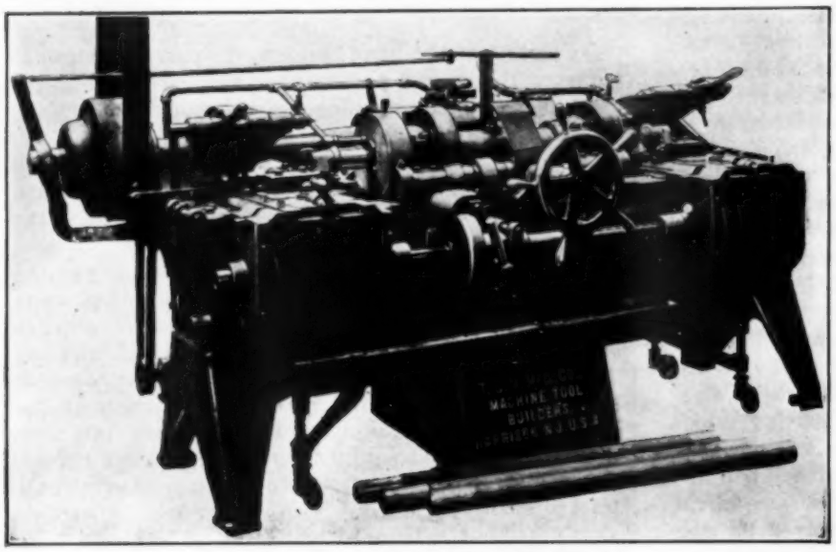
The accompanying illustration shows a special semi-automatic machine built by the T. C. M. Manufacturing Co., Harrison, N. J., for machining automobile and truck axle shafts of the full floating type. The shaft to be machined is placed in the hollow spindle of the machine and is held by two scroll chucks, one at each end. The two chucks are operated simultaneously by means of the handwheel shown at the front of the machine. Once started, the machine squares the ends of the shaft to length, turns down each end to the correct diameter and forms a bevel at one end and a check at the other.

The operator then swings the two center drilling spindles into position and centers both ends at once. These centers are required for the remaining operations such as holding the splines and for the finishing of the axles by grinding.

Two of the slides make several movements across the work, during each cycle of the machine, the tools being advanced the amount of the cut to be taken before each passage of the tool is begun.

The other slides are moved along the bed by cams which engage with cam rollers set in the bed, each slide carrying a cross slide controlled by separate cams. Variations of diameter are taken care of by screw adjustments on each cross slide.

To enable adjustments from one size of shaft to another to be made quickly, the slides at one end of the machine, with the corresponding drilling spindles for centering and the adjacent spindle bearing are all tied by bars to a bracket which can be moved along the bed so that by loosening the clamping bolts and turning the adjusting screw, all the required length changes are made simultaneously. A pump supplies the coolant to each cutter and a pan is provided to catch the chips with a tank to supply the pump. The cutting tools are either circular formed tools or may be solid rectangular tools as desired. The finished shaft is ejected from the machine by a bar which pushes the shaft far enough out so that the operator can remove it. Three spindle speeds and three feeds are provided for by quick-change gears. The hollow spindle is telescopic and the slides at one end of the machine are adjustable so that shafts varying in length from 36 to 48 in., and in diameter from 1¾ to 2¾ in. can be handled. The time required per shaft varies from four to ten minutes according to diameter and cutting quality of the forgings. The drive is through a single belt and clutch pulley.

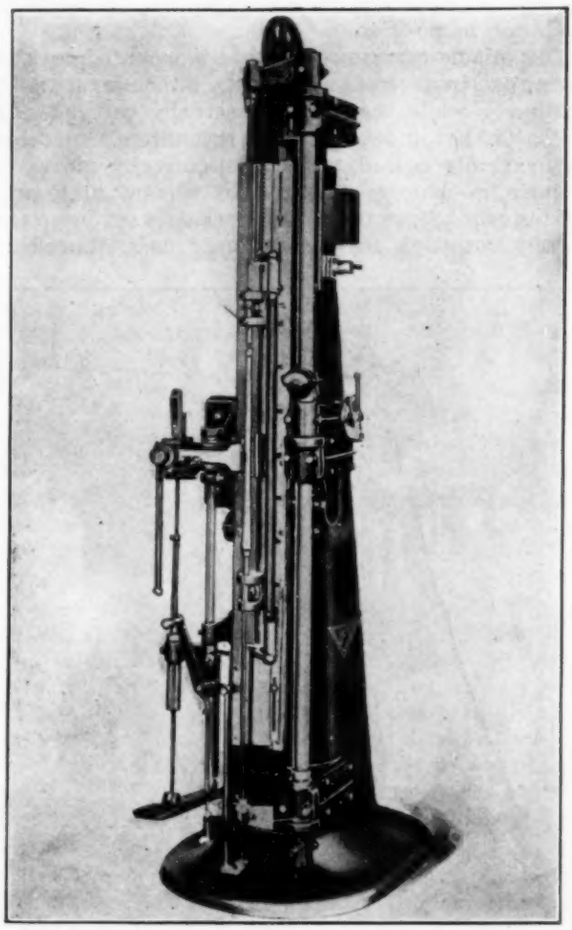


T. C. M. SEMI-AUTOMATIC MACHINE

Fairbanks Gun Barrel Calibrating and Straightening Machine

The illustration shows a calibrating and straightening machine for use on gun barrels, which has been developed by the Fairbanks Company, Broome and Lafayette Sts., New York, N. Y. It is said that this machine will straighten rifled barrels as easily as smooth bores, and that the method of testing for straightness is thoroughly scientific, precluding the possibility of error. The skill that has heretofore been required for this operation now becomes unnecessary, and it is claimed that an unskilled workman can, with a few hours' experience, straighten gun barrels to within a fraction of a thousandth of an inch. The claim is also made that barrels can be straightened to within 0.002 in. for their entire lengths, and in less time than is usual with the older methods.

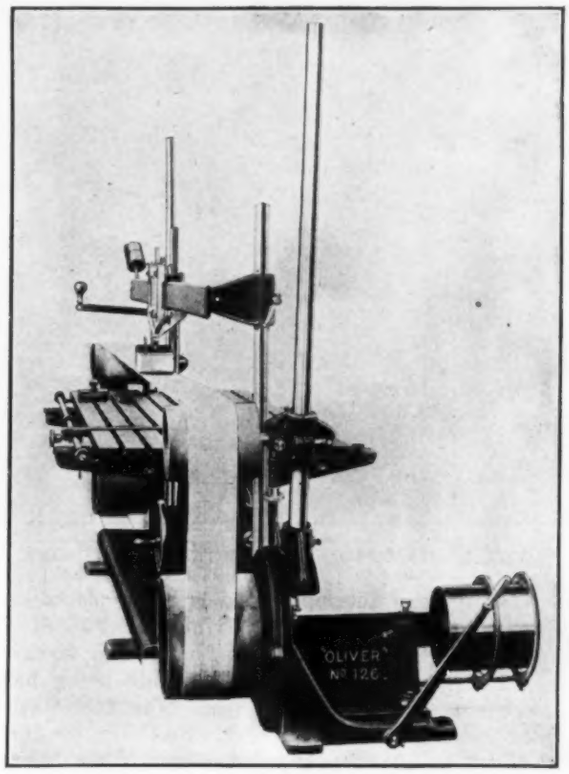
In operation, the gun barrel is held in a vertical position in the machine where it is rotated about its axis by the operator, thus bringing every part of the bore to pass by a fixed point or "feeler" within the bore, the barrel being raised or lowered to test the bore throughout its length. Whenever the feeler comes in contact with the bore it completes an electrical circuit which registers on a voltmeter. The amount of error is determined by moving a handle on a micrometer screw adjustment until the contact is broken. The error will be shown to 0.00025 in. When the peak of the crook has been determined both vertically and circumferentially by indications of the voltmeter, two jaws are brought into contact with the barrel and the necessary pressure is applied to correct the error. It is stated that the barrel can be placed in the machine and removed in less than two seconds. It is said that the machine is substantially built, has no parts to wear out, and will turn out perfect work indefinitely.



FAIRBANKS GUN BARREL CALIBRATING AND STRAIGHTENING MACHINE

Oliver No. 126 Belt Sanding Machine

The machine shown in the accompanying photograph is the Oliver No. 126 belt sanding machine which has been put on the market by the Oliver Machinery Co., Grand Rapids, Mich. The machine is intended for the rapid sanding and polishing of all kinds of metal parts and should be particularly adaptable in automobile body factories, implement factories, etc.



OLIVER NO. 126 BELT SANDING MACHINE

This machine is said to be quick in action, convenient for the operator and very safe. As shown, the machine is set up so that there is no overhead belt. The slack in the belt is taken up by means of a countershaft, so that a flexible tension to suit the work is maintained. The idler is adjustable up or down to height of work and can also be adjusted to a tilting position to keep the sand belt from running to either side of centers. The table top is constructed of plain wood strips with 1 in. gaps.

The table is 32 in. wide and 96 in. long and is equipped with an adjustable bar to hold work to be sanded. The machine is regularly equipped with roller bearing countershaft for belt drive, or arranged for motor drive. Equipment consists of one sanding shoe, necessary wrenches and edging attachments. The machine has a capacity to take work any length and sand to center of 72 in. It will take work on the table 54 in. high and over floor 72 in. high. The table travels 36 in. with a vertical adjustment of 14 in. Sanding belts up to 10 in. wide may be used. The weight is about 1,400 lb., and height over all, about 80 in.

Garrison Automatic Gear-Grinding Machine

A machine for grinding gear teeth by means of a wheel having a section like that of a rack tooth and which generates the bearing surfaces on the gear teeth

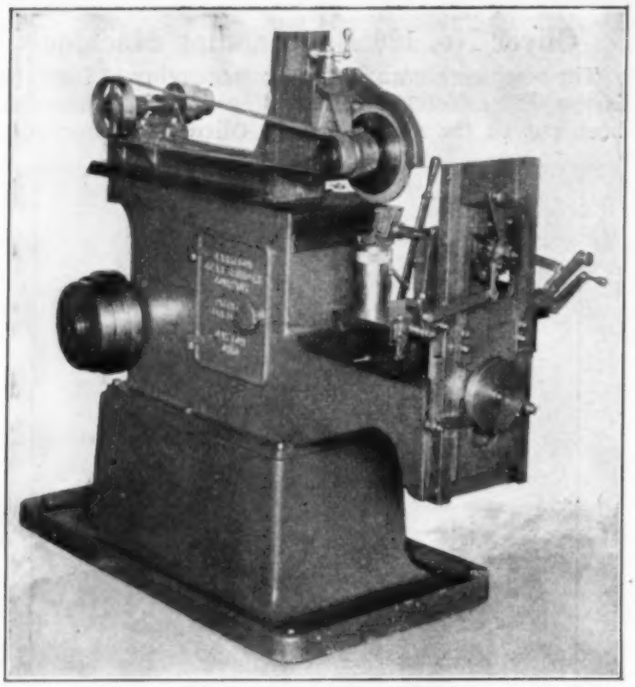


FIG. 1. GARRISON GEAR-GRINDING MACHINE

has recently been developed, and is being placed on the market by the Garrison Gear Grinder Co., 26 St. Clair St., Dayton, Ohio. A general view of the machine is shown in Fig. 1, the gear to be ground being held on the arbor seen below the wheel. The teeth are not formed by means of a formed wheel nor by the use of a templet; but they mesh and roll with the tooth-shaped abrasive wheel, so to obtain a true bearing surface. A master gear and rack are employed for each different size and type of work, the tooth form of the master gear being that required on the work; and the accuracy of the work put out, of course, depends largely on that of the masters.

The motions of the various members of the machine when in operation are as follows. Besides rotating, the wheel is caused to reciprocate horizontally. It thus runs back and forth through the spaces between the gear tooth, the work being indexed entirely around without changing its position in relation to the wheel, so that the wheel passes once through each space. The table on which the work is mounted is then moved transversely to the wheel, the work is rolled slightly and the operation is repeated. Thus, after a series of steps, each tooth is completely ground on the contacting surface, the result being the same as though each tooth had rolled with the wheel as it would roll with the tooth of a rack. The small allowance left after roughing is, consequently, removed from the bearing surfaces, so that they are ground to involute form.

The base and bed are of box section, the former having a trough around its edge and the latter housing part of the mechanism. On top of the bed, a reciprocating ram 28 in. long, carrying the wheel mechanism, is mounted on dovetailed ways. The drive is from an overhead countershaft to the small three-step cone pulley. The shaft of this pulley is hardened and ground, running in cast-iron bearings and it carries a pulley which drives the wheel. A 10 x ½-in. wheel, running under a guard, is used. As the wheel wears down, the steel disks can be changed, so that it may be used down to 6 in. in diameter. The speed may be maintained, however, by changing the position of the belt on the cone driving pulleys. The wheel spindle is mounted on two S. K. F. self-aligning, double-row ball bearings on a carriage which has a vertical movement of 1 in. by means of a feed screw provided with a dial. The position of the whole head may be adjusted vertically, after loosening its fastening bolts.

The automatic movements of the machine are driven from overhead by a separate belt running on the three-step cone pulley at the rear of the machine. An expanding-band friction clutch is fitted inside the pulley, for use in starting and stopping the mechanism. In Fig. 2 can be seen the hand lever operating the clutch. The pulley on the side of the machine drives, through bevel gears, a crank having a vertical shaft and operating the ram, which can be given a speed of 23.6 to 40 ft. per minute. It also drives a horizontal shaft extending through the knee which is cast solid with the bed.

The position of the end of the shaft is shown by the disk on the front of the knee. Behind the disk are carried two cams, one of which serves to raise and lower the slide carrying the master rack, seen best in Fig. 1. The other cam causes the master gear, and also the work, to index one tooth between each stroke of the wheel. Thus, while the wheel touches the work the master rack and gear are meshed, so as to hold the work in position.

The spindle carrying the gears is mounted on a table having a transverse movement, although it is held stationary while the wheel is actually cutting. After the work has indexed a full revolution, the table is automatically caused to move slightly by means of a suitable mechanism operated by a cam back of the master gear. Since the master rack does not move transversely, although the master gear does, the effect is

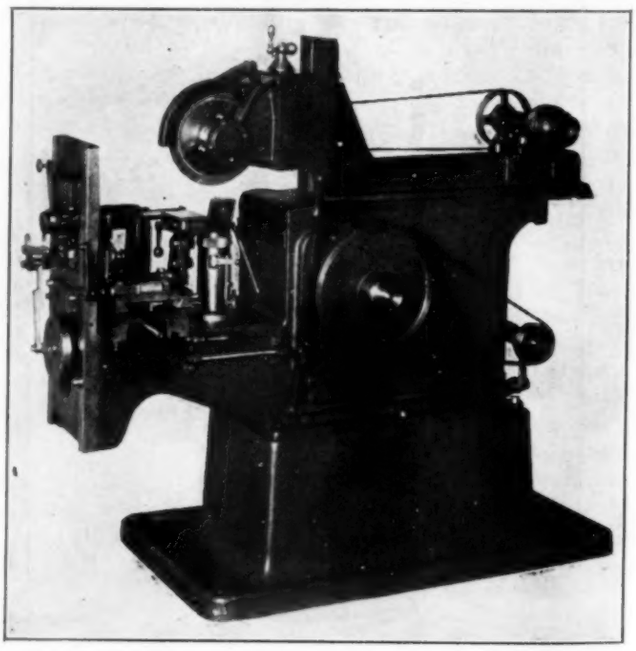


FIG. 2. CONTROL SIDE OF GARRISON GEAR-GRINDING MACHINE

to roll the work slightly. The wheel, being always aligned with the central tooth of the rack thus touches a different place on the teeth of the work, the result of a number of these steps being to generate an involute on the gear tooth.

The amount of movement of the slide can be controlled by the small vertical screw seen just to the right of the rack slide in Fig. 2. This adjustment permits of making the steps as small as necessary to obtain a continuous curve on the tooth. For a 6 to 8 pitch, 20 tooth gear, a cross movement of 1½ in. made in ⅜ in. steps is ordinarily used. To clear the work from the wheel, the slide can be brought to the right by means of a lever.

The movements are provided with automatic stops, so that at the completion of a gear the machine stops entirely, except for the rotation of the wheel. There is, also, a jaw clutch in the knee by which the movements on the latter can be stopped while the ram still reciprocates. In order that each gear may be quickly clamped on the arbor with the proper relation to the master gear, the stop to be seen at the right of the arbor is employed. It has a small vertical slide which can be brought into the tooth space of the gear, after its position has been adjusted.

An ingenious wheel-truing device is mounted directly beneath the wheel. Two diamonds are carried on the same bar. The one on top is for truing the periphery of the wheel, the top of the device being merely rotated to accomplish this. The other diamond dresses the sides of the wheel, being caused, by means of a lever, to move up and down on a slide placed at the proper angle. To dress the other side of the "V," the top of the holder is merely indexed through 180 deg. and locked. After the diamonds have been properly set for a given job by means of the screws provided, it is necessary to make no further adjustments, but merely to feed the wheel down and to redress. A different head for the device can be furnished for the required pressure angle on the gear, although it is not necessary to have different master gears for each pressure angle, provided that the number of teeth and the diameter are the same.

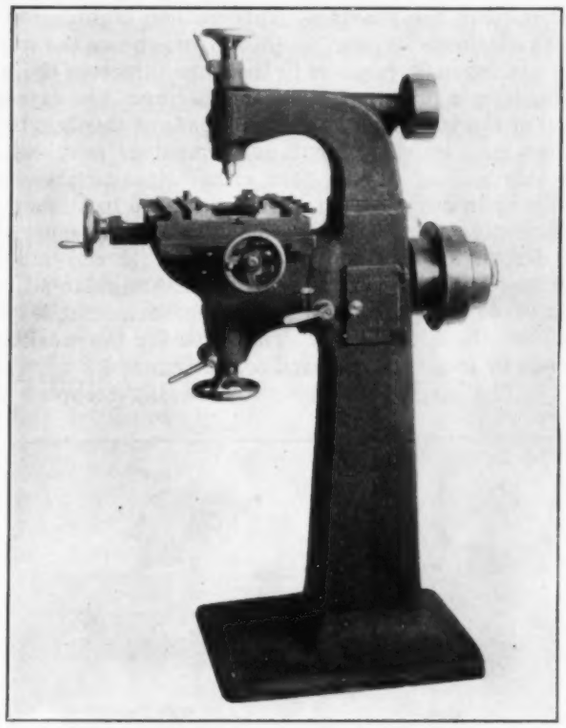
The machine can handle gears having pitch diameters from 2 to 9 in. Although the wheel stroke is 6¾ in., the grinding stroke is only 3 in. Several gears having small face widths can thus be mounted at one time. Although the machine is shown fitted with an arbor or holding gears having through holes, special fixtures can be furnished for other styles, such as gears integral with shafts.

The machine ordinarily removes 0.007 to 0.012 in. of stock from the thickness of the tooth, the roughing requiring but one previous cut, either milling or hobbing. It is said to be very rapid in its operation, a 20-tooth, 6-pitch gear being ground complete in 6¼ minutes. It is claimed that the gears produced checked to within 0.00025 in. on the shape of the involute, and to 0.0006 in. on the two-pin thickness test of the teeth. The direction of rotation of the wheel is such that it cuts against the tooth on the return stroke, which is said to leave an excellent finish. Because of the narrow surface touched at each cut and the indexing of the work, the work does not become heated, it is said, so that accuracy can be maintained.

The machine measures 57 in. overall from front to back, 28 in. from left to right, and 54½ in. high. Its weight is about 1,500 pounds.

Johnson Die Milling Machine

The Johnson Tool Co., 201 Eddy St., Providence, R. I., has recently placed on the market a die milling and cutter plate machine, designed especially for use



JOHNSON DIE MILLING MACHINE

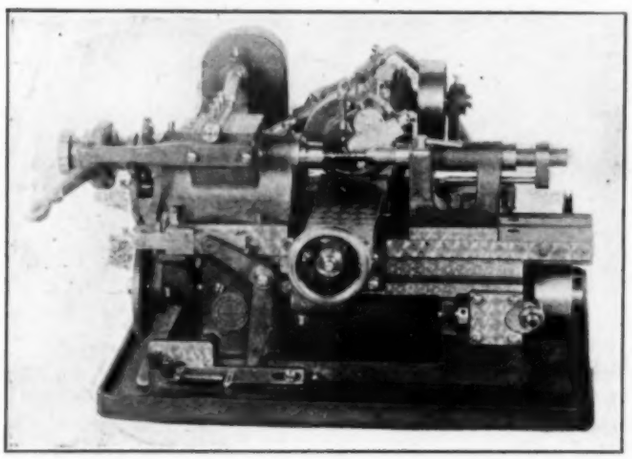
in the manufacture of punching dies and hubs. As will be seen by the illustration, the machine is provided with a tilting table, which has a capacity of 9 in., when not fitted with jaws; when jaws are used the capacity is 5½ in. The machine has two spindles, one carried under the vise table and the other above the table. The head in which the upper spindle is carried can be swung out of position when not in use, which is a labor-saving feature. Both spindles have been provided with taper bearings for taking up wear, and special adjustment has been provided for taking up the wear on both cross and longitudinal screws. A clutch arrangement inside the cone pulley allows the lower spindle to remain stationary while the upper spindle is in use. The crossfeed is 4 in. and the lateral feed 6 in. The height from the floor to the top of the table is 40 in. The cone pulley has two steps, the width of the faces being 2¼ in. The machine occupies a floor space of 29 x 40 in. and weighs 600 pounds.

Waltham Automatic Thread Milling Machine

An automatic thread milling machine, intended for manufacturing purposes and so designed that it may be equipped for a variety of work, has been placed on the market by the Waltham Machine Works, Waltham, Mass. The automatic features of the machine are intended to make it possible for a number of machines to be handled by one operator. After the work has been placed in position, the movements of feeding the cutter into the work, the milling of the thread, the withdrawal of the cutter after the required length has been milled, the returning to the starting point, and the stopping of the machine are wholly automatic. The length of the

thread is the same as the amount of rise of the cam that controls the workslide, its pitch being determined by the relation between the gearing from the workhead to the camshaft and the lead of the workslide cam. The indexing for multiple threads is obtained by a fractional proportion in the gearing. This method of indexing is said to eliminate all possibility of error, and as the workhead continuously revolves in the same direction there is no backlash to produce inaccurate spacing. The extreme travel of the workslide is 2 in. Threads of this length or shorter may be milled, but adjustment is provided so that this milling can be done either close to the work spindle or in any position not more than 6 in. distant.

The cutter spindle and its drive are of the same size and design as those of the Waltham thread milling machines built by the same firm. An angular adjustment of 45 deg. on each side of the horizontal is provided for the cutter head. The drive for the workhead is made by means of a geared connection and a universal joint. The mechanism for automatically stopping the



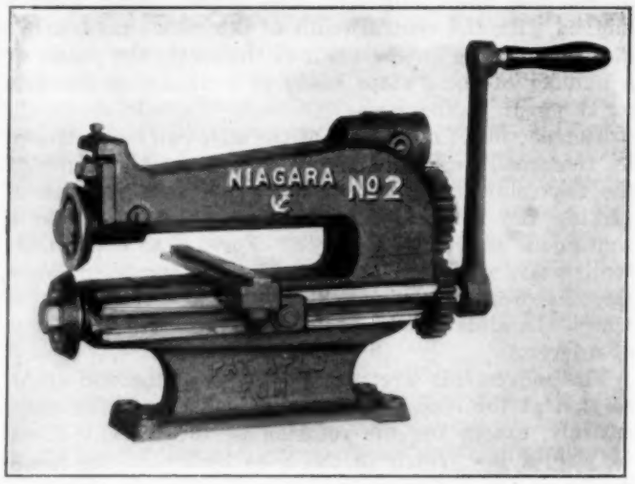
WALTHAM AUTOMATIC THREAD MILLING MACHINE

machine can be adjusted so that the machine will stop at the end of one revolution of the camshaft or after any predetermined number of revolutions that are necessary when cutting multiple threads.

The machine shown in the photograph was equipped for cutting multiple threaded worms such as are used in phonographs, electric fans, vacuum sweepers, and so forth. By a slight change in the design it can be made to cut helical gears. For brass work the all-gear drive would be omitted and a special high-speed belt-driven cutter-head provided. The machine is designed for single purpose work and at the present time is built to order only.

Niagara Slitting Gage Applied to Re-designed No. 2 Slitting Shear

The Niagara Machine and Tool Works, Buffalo, N. Y., has recently developed a slitting gage for a rotary sheet-metal shear, an application of which, attached to a No. 2 Niagara slitting shear, is shown in the accompanying illustration. As can be seen, the purpose of the gage is to provide a simple though effective means of guiding work through the shearing machine. The gage is easily adjusted, one lock-bolt being sufficient to hold it firmly in position. Perfect alignment is assured by the fact that the lock-bolt has a large T-head



NIAGARA SLITTING GAGE APPLIED TO RE-DESIGNED NO. 2 SLITTING SHEAR

which slides in the guideway, the bolt protruding through a guide block on the outside of the guideway. When the nut is tightened on the lock-bolt, the gage is locked firmly in position.

The No. 2 Niagara slitting shear has been re-designed and is now a miniature of the heavy Niagara slitting shear.

Milwaukee 9-Inch Shaper

The machine shown in the illustration is the Milwaukee 9-in. shaper which has recently been placed on the market by the Milwaukee Shaper Co., 1023 Cold Spring Ave., Milwaukee, Wis. This machine was designed for toolroom and similar work.

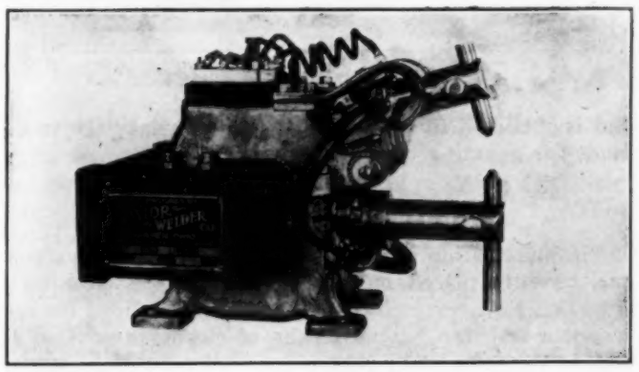
All iron castings used in the construction of the machine are said to contain 40 per cent of steel, and the base and frame are claimed to be ribbed sufficiently to resist all strains that they may be subjected to. The ram is designed for strength, wide bearings and V-shaped ribs, scraped to an accurate fit with the ram gibs, tending to eliminate vibration and make it easy to take up wear. The crossrail has wide bearing surfaces, scraped to the bearings, and the apron is provided with a taper gib to take up wear in the crossrail. The toolhead is graduated, swivels to an angle through an arc of 60 deg., and is provided with micrometer adjustment. The table is 8¾ in. long and 8 in. wide, and can be tilted 8 in. vertically to either side. The swivel vise has a graduated base, steel jaws, and an extra set of jaws for taper work.

MILWAUKEE 9-INCH SHAPER

Taylor Bench Type Spot-Welding Machine

The Tayler Welder Co., 12 Atlantic St., Warren, Ohio, has developed a welding machine known as the S-4-B bench type which is shown in the accompanying illustration.

The machine has a cast copper frame which acts as secondary, an arrangement said to make it very efficient. The horns are of cold drawn copper, 1¾ in. in diameter, and are cooled by a stream of water which circulates in both horns. The lower horn is adjustable to three positions. The distance between the horns is 3 in. when closed in the upper position and 5 in. in the lower position. Current is applied through an automatic single pole switch, stepped down through a 3 kw. transformer, which has a four-stop regulator for adjusting the current. The machine is designed for light work such as welding, brazing and soldering. Its particular field is spot welding light gages of sheet metal; cross wire welding; contact points of platinum or tungsten



TAYLOR BENCH TYPE SPOT-WELDING MACHINE

to steel; brazing and soldering of small parts of electrical instruments; watch cases, optical goods, and welding of gold to German silver or steel; small laboratory work. Dimensions: floor space, 10 x 17 in.; extreme height from bench, 12 in.; bench to welding dies, 6¾ in. Capacity: two pieces of No. 30 to No. 16 gage sheet steel. Weight, approximately 150 pounds.

Thermit Welding Molding Material

A molding material for thermit welding has recently been developed by the Metal & Thermit Corporation, New York, which, it is claimed, when used in accordance with the regular thermit practice, will prevent blowholes and assure sound welds.

The composition of this material is based on the theory that good silica sand will stand the heat of thermit reaction very well and that the weakness in all molding materials is the clay binder. There should be as little clay as possible in the mixture, in order to make the mold more refractory and to increase its porosity. Therefore a plastic clay has been selected instead of a fireclay. The sand and plastic clay are ground together in a foundry pan or moller so as to coat each grain of sand with a minimum thickness of clay. This method has resulted in a good, clean molding material which, if rammed hard in the mold, will stand up well under the preheating flame. It is extremely porous and it is claimed that by its use a sound weld with a very clean exterior can be made.

The material is composed of three parts clean, sharp silica sand (all of which should pass through a screen having a 0.03-in. square opening, and 40 per cent of which should be retained on a screen having a 0.012-in. square opening), mixed with one part Welsh Mountain plastic clay. The ingredients are first thoroughly mixed in the moller together with one-fortieth part glutrin by volume and sufficient water (one-twelfth part) to bring them to the proper consistency. If mixed by hand, the sand and clay must be dried, being careful not to subject the clay to a temperature higher than 400 deg. F., and then thoroughly mixed before adding the glutrin and water. The glutrin should be mixed with the water before adding to the sand and clay.

Dumore Bench Type Portable Electric Drill

The illustration shows the Dumore model 2-BD bench type portable electric drill which has been developed by the Wisconsin Electric Co., Racine, Wis. The motor is the Dumore universal type, operating on either direct or alternating current, 25 to 60 cycles. Power is delivered to the drill through heat-treated gears of the helical type. The spindle runs in self-aligning annular ball bearings. The capacity in steel is ¼ in., and in wood ⅜ in. The motor and gearing are encased in an aluminum housing. The feed is through rack and pinion. The table is adjustable. The drilling strike is 3¼ in. A No. 1 Jacobs chuck, 10-feet of portable cord, plug and switch are supplied as regular equipment. The net weight is 21 lb. and the shipping weight, 27 pounds.

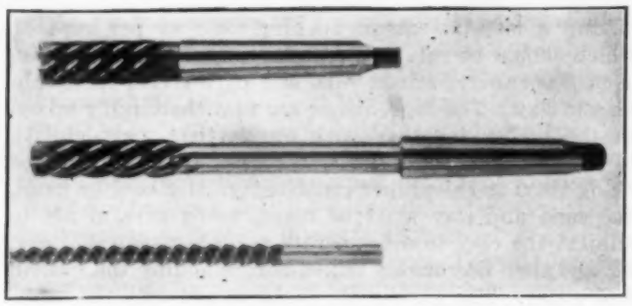
DUMORE PORTABLE ELECTRIC DRILL

Gammons End Mill and Reamers

The Gammons-Holman Co., Manchester, Conn., is placing on the market the style of helical-fluted end mill and chucking reamer shown in the illustration. The tools are similar to the concern's taper-pin reamer described on page 750, Vol. 52, of the *American Machinist*, in that the twist is carried to a greater extreme than is the usual practice. The angle of helix is reversed from the direction of rotation; that is to say, a left-hand helix is applied on the reamer and right-hand end mill; while the left-hand end mill has a right-hand helix.

It is claimed for this construction that heavy cuts may be taken without chatter, and that the tendency to "draw in," which is particularly noticeable in the operation of reaming, is entirely counteracted. A further advantage claimed by the makers is that a hole may be reamed to cut out into another hole for a considerable part of its diameter without the snagging and consequent breakage that would ordinarily follow such practice with a straight-fluted tool.

Both the chucking reamer and the end mill are made



GAMMONS-HOLMAN REAMERS AND END MILL

in all commercial sizes up to 2 in. in diameter, and larger sizes to order. The taper-pin reamer, shown at the bottom of the accompanying illustration, is now made in fifteen sizes, ranging from 0.101 in. at the small end of the smallest reamer to 1.050 in. at the large end of the largest. The sizes overlap, rendering it possible with the full set to ream any sized hole within these limits. It is claimed that the reamer can be run three-fourths as fast as a twist drill of the same size, and that there is little danger of it becoming stuck in a hole, as the left-hand helical flutes, which are ground to cut when rotating in a right-hand direction, automatically free it if any obstruction is encountered.

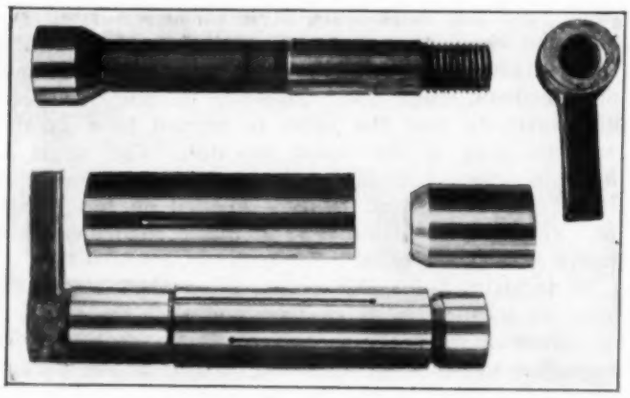
Bath Expanding Mandrel

The expanding mandrel shown in the cut is made by John Bath, Inc., Worcester, Mass., for use on cylindrical grinding machines where accurate workmanship is a prime requisite.

The body of the mandrel has a conical shoulder under the head which matches a similarly shaped cavity in the end of the split sleeve, while a loose bushing is fitted in the same way to the other end of the sleeve. The driving dog, which screws upon the outer end of the mandrel, serves the double purpose of driving the work and of expanding the sleeve in the bore of the piece to be ground, by forcing the two cones together.

The bushing is accurately fitted to the body of the mandrel but the split sleeve bears only upon the two conical shoulders. The sleeve has six slots cut alternately from either end so that the expansion is practically uniform over its length.

In making the sleeve the slots are not cut all the way to the end, but a small triangular section of metal is



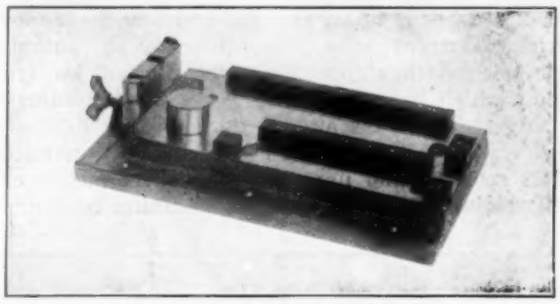
BATH EXPANDING MANDREL

left by the saw to bind the piece together in the hardening operation. After hardening, these small sections are cut out with a thin elastic wheel.

All parts are, of course, carefully ground and lapped after hardening and the final grinding of the sleeve to diameter is done with the tool assembled. The mandrel is made in all sizes from 1 to 5 in., one body and bushing accommodating several sizes of sleeve. The cut shows the tool both in detail and assembled.

Kelly Plain Bench Plate

The bench plate shown herewith is one of the adjuncts furnished by the Kelly Reamer Co., 3705 W. 73rd St., Cleveland, Ohio, for taking care of "Kelly" reamers,

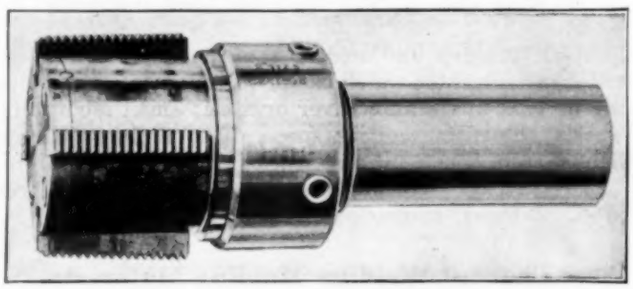


KELLY PLAIN BENCH PLATE

and is intended to be used when adjustments are to be made for grinding the cutters.

Geometric Adjustable Tap

The illustration shows a threading tool or adjustable tap recently placed on the market by the Geometric Tool Co., New Haven, Conn. The tap is intended for use where a machine has no means of closing a collapsible tap, or for some other reason does not permit the use of



GEOMETRIC ADJUSTABLE TAP

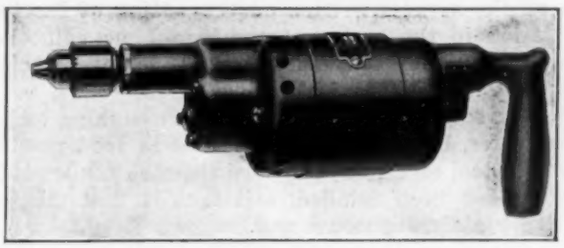
a collapsible tap, being intermediary between an adjustable collapsing tap and a solid tap.

The tap is not equipped with a collapsing device, but is claimed to have all the other advantages of a collapsing tap. Being adjustable, correct size can always be maintained. Each size of tap accommodates chasers for a range of diameters, and the chasers can be readily removed for regrinding. When necessary to renew the chasers, this can be done at slight cost, being a saving over the renewing of an entire tap, as when solid taps are used.

Dumore Model 1-BD Portable Electric Drill

A small portable electric drill, known as the Dumore model 1-BD, has been placed on the market by the Wisconsin Electric Co., Racine, Wis. This drill, which is shown in the illustration, is built for use in drilling small holes where speed and adaptability are prime considerations. The motor used is the Dumore univer-

sal type, operating on either direct or alternating current, 25 to 60 cycles. The power is delivered to the drills through heat-treated, steel gears of the helical

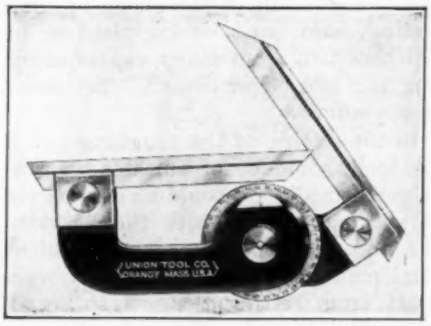


DUMORE MODEL 1-BD PORTABLE ELECTRIC DRILL

type. The shaft on which these gears are mounted is ground to size. The motor and gears are encased in an aluminum housing, the length over-all being 12½ in. The drill spindle runs in two self-aligning ball bearings, and is offset from the center 3½ in. Jacobs chucks are furnished as standard equipment. The capacity of the drill is, for steel, ¼ in.; for wood, ⅜ in. The net weight is 5 lb.; shipping weight, 8½ pounds.

Union Universal Bevel Protractor

The bevel protractor illustrated has been placed on the market by the Union Tool Co., Orange, Mass. It is so designed as to cover a very wide range of work. The dial is graduated to a full circle of 360 deg. and may be set at any angle. It is securely held in whatever position it may be set by means of a knurled thumbscrew.



UNION UNIVERSAL BEVEL PROTRACTOR

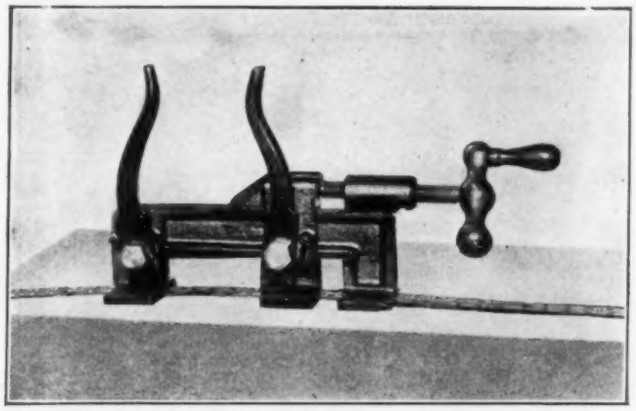
Both the stationary and movable blades may be adjusted to any position lengthwise, and when tightened by means of the clamping screw are drawn to a firm bearing in their respective seats by the action of the clamping device.

The blades and the clamping devices conform to the related parts of the combination square made by the same company and the 12-in. adjustable blade of the square may be substituted for that of the protractor, if desired. The blades and all working parts are of tool steel, hardened and ground.

Hill Box Banding Clamp

A device for stretching metal bands tightly upon packing cases, as is commonly done when packing heavy parts, especially in the case of foreign shipments, has been placed on the market by M. B. Hill, of Worcester, Mass. The device is quite simple and does easily and quickly a job that would be difficult of accomplishment by hand.

To operate it, the band is placed around the case in the desired position and the ends passed under the cam levers of the device. The movable jaw is then advanced along the frame by means of the screw until the requisite tension is put upon the band and the band



HILL BOX BANDING CLAMP

is nailed to the case as close to the device as may be convenient.

The screw is then loosened, the ends of the band are released from the cam levers, the device is removed and the free ends of the band are tacked down.

Union Surface Gage

The Union Tool Co., Orange, Mass., has added to its line of machinists small tools, the surface gage shown herewith.

The spindle may be set at any angle with the base over a radius of 270 deg. and tightened in position by means of a draw-sleeve and knurled nut. Close adjustment is provided in any of the positions by the small regulating screw at the end of the lever that carries the spindle.

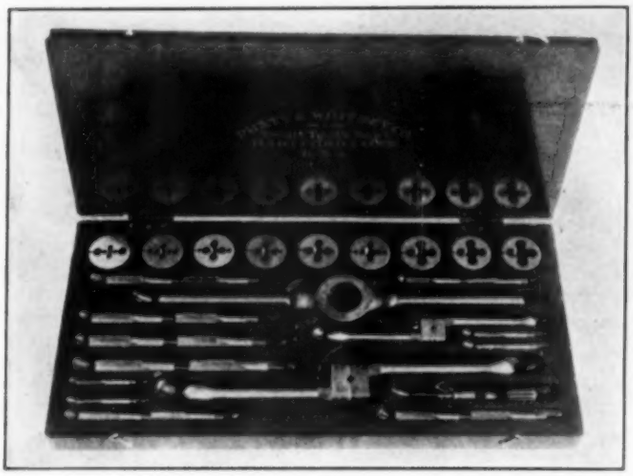
A V-slot in the base provides for the use of the tool in connection with round work and a pair of push plugs in each end of the base enables the user to line up work from the top, side, or bottom of a plater or in correct relation to a slot in the work. The draw sleeve is provided with an extra hole to take the needle, so that the spindle may be removed and the gage used without it, retaining all the facility of adjustment without the range of the complete tool.

UNION SURFACE GAGE

The base is enamelled and all working surfaces are ground and polished. The base is 3⅞ in. long by 2⅜ in. wide. The height of the spindle is 12 in. The tool weighs two pounds.

Pratt & Whitney Screw Plate Sets

The Pratt & Whitney Co., Hartford, Conn., has placed on the market a screw plate set, as shown in the illustration. The taps and dies included in these sets are some of the regular product of this company, selected



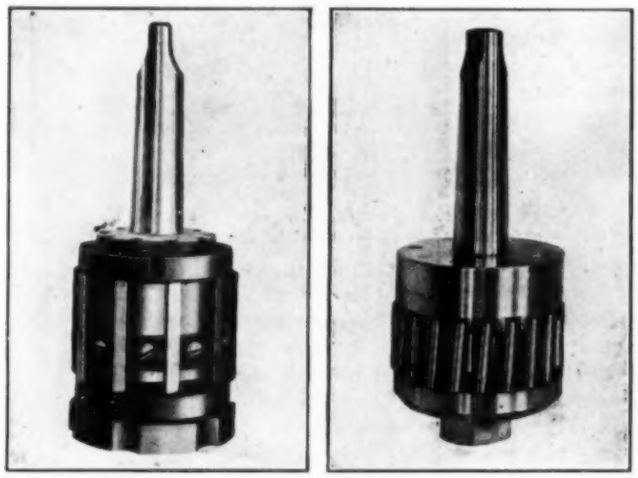
PRATT & WHITNEY SCREW PLATE SETS

to meet the requirements of the small shop, garage and toolroom. The various sets include from five to nine sizes of taps, either taper or plug or both, with corresponding dies. Either U. S., S. A. E., or Whitworth Standard threads are furnished as desired. The sets containing five or seven sizes of taps and dies also include one tap wrench and one die stock, while the sets of nine sizes contain two tap wrenches and two die stocks. Each set is packed in a finished case, suitably marked and including screwdriver.

Indiana Reamer and Burnishing Tool

The Indiana Tool Co., Richmond, Ind., has placed on the market the reamer and burnishing tool shown in the illustrations for use on cylinders of Fords and Fordson trucks. These tools are said to be similar to those now in use at the Ford plant and other motor plants. It is claimed that the use of these will give the cylinder walls a smooth, hard finish, superior to that obtained by other methods.

The reamer contains ten inserted blades of high-speed steel and of extra lengths to allow for grinding. The method of holding the blades keeps them at proper



INDIANA REAMER AND BURNISHING TOOL

adjustment. The pilot, which is of tool steel, hardened and ground, is free to turn and guide the reamer.

The burnishing tool contains twenty floating rollers, made of high-carbon steel and hardened and ground.

Know Why You Do Things

By H. M. Ayrbn

In all the articles written on the setting of the tool in relation to the center of the work, one point has been ignored and that is the fundamental principle underlying the setting of the tool.

The correct theoretical position of a roughing tool is above center, but it has been accepted as good practice to set the tool on center, provided that the fundamental principle has been fulfilled, and that is that the tool shall be rigidly supported and securely fixed.

When these conditions do not exist other means must be taken to overcome the trouble and turn out the required quality of work in satisfactory time. The workman possessing the ability to perform the above in any workshop and on any type of lathe should be considered as a capable mechanic.

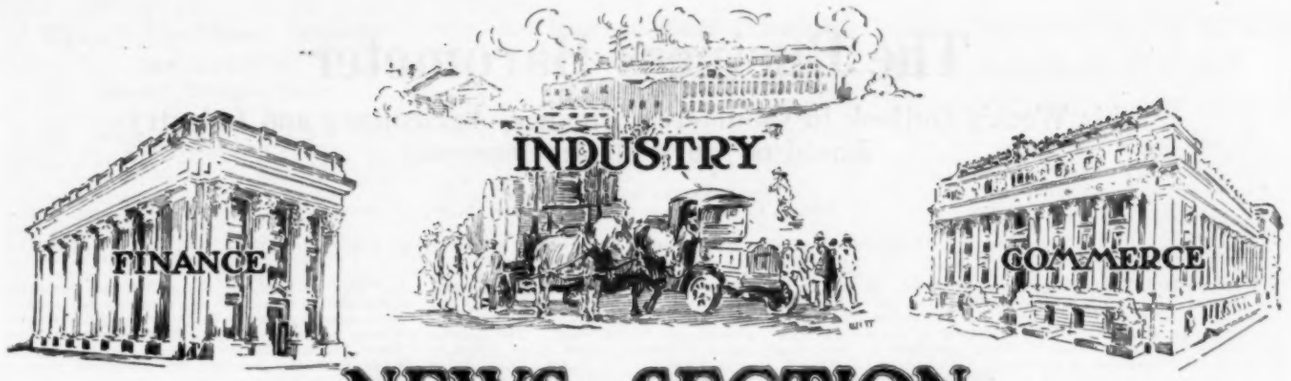
On page 72, Vol. 54, of *American Machinist*, Mr. Forbes shows a sketch of part of a lathe so distorted as to make clear his reasons for setting the tool below center. There is one point that I think he has overlooked and that is the overhang of the tool, as shown, and unless the feed used is very fine or the cut light the looseness of the V's will increase the trouble of digging in and necessitate setting the tool very low. In the rough-turning of heavy work where the feeds used are coarse and the cut heavy and not of an equal depth on account of the shape of the rough forging or casting, care must be exercised to prevent digging-in which occurs from many causes, and, apart from setting the tool below center, other means must be taken to prevent it.

In the setting of the roughing tool it is accepted that the tool should be of suitable weight for the work to be performed and should be held as rigidly and securely as possible. But where the heaviest tool procurable, say 2-in. square steel, proves inadequate to the task, what methods are we to adopt to overcome the troubles apart from setting the tool so very far below center that the slide rests will require to be made so very tight that they cannot be moved with freedom?

The feed or the cut can be reduced but these expedients are ruled out as they increase the time on the job. Another method is to clamp a tool of the same section of steel on the top of the cutting tool to give the required rigidity. Should this prove inadequate, bolts or packing pieces may be used to support the slide. Where it is necessary to have the tool overhanging to perform such work as roughing crankshafts, the tool should be supported by a jack of suitable proportions; the base of the jack resting on the lathe carriage.

The spring tool mentioned by Mr. Forbes in the above-mentioned article is a tool that should not be set on center but below it, for the same reason that the cutting edges of circular form tools are cut below the center of the cutter; and that is (apart from giving the necessary clearance) that the tool will continue to cut long after it has lost the initial keenness and so eliminate the necessity for continual grinding and re-setting.

In the finish turning of circular form tools the master tool is set below center the same amount as the center of the cutter will be above the work center when in use (see "American Machinist Handbook," pages 250 to 254). This is necessary in order to obtain the correct formation.



NEWS SECTION

Canada Orders All Imports to Be Marked as to Origin

The Dominion government has just issued regulations to govern the marking of imported goods, as required by an amendment to the customs act at the last session of the Dominion Parliament. The new law, which becomes effective on Jan. 1, 1922, follows closely the wording of the corresponding section in the United States tariff in requiring that "all goods imported into Canada, which are capable of being marked, stamped, branded or labeled without injury, shall be so marked in legible English or French words, in a conspicuous place . . . so as to indicate the country of origin."

All goods imported into Canada which do not comply with the new requirements are made subject to an additional duty of 10 per cent on the value for duty purposes, and in addition, will not be released from customs possession until they have been so marked, stamped, branded or labeled under customs supervision, at the expense of the importer. This provision is of great importance by reason of the volume of United States goods exported to the Dominion. For the last fiscal year the value of United States products imported into Canada for consumption was no less than $856,613,430.

Goldsmith Heads European Division of Commerce Department

Allen Goldsmith of Dayton, Ohio, has been appointed chief of the European division of foreign and domestic commerce, by Secretary of Commerce Herbert Hoover.

Mr. Goldsmith is a graduate of Kenyon college and served in the World War with the rank of Lieutenant-Colonel. Following the signing of the armistice, Goldsmith was assigned to duty under Hoover and placed in charge of the Rumanian food mission, with offices at Bucharest. In 1920 he was placed in charged of the American relief warehouses at Hamburg, Germany, and later transferred to Triest, Italy, for the distribution of food to the Austrians.

Milliken Bros. Get Australian Contract

A contract totalling approximately 75,000 pounds sterling, plus freight, was recently awarded to Milliken Brothers of New York, according to the announcement by the electricity commissioners of Melbourne, Australia. It covers the erection of a 112-mile line bringing high tension power from Victoria Falls, Australia, to Melbourne, and includes a total of 634 steel towers to carry a current of 132,000 volts.

One of the vice-presidents of Milliken Brothers is already en route to Melbourne to start the work. His company reports work under way also for contracts in Burma, South Africa and Norway, among other foreign countries.

Venezuelan Trade Agency Established in Boston

Carrying out the plan of the Venezuelan Minister of Foreign Relations to promote trade with this country, E. Arroyo Lameda, recently appointed commercial attache in Boston, Mass., has opened offices in the Little Building, that city. He will supply manufacturers, jobbers, exporters, importers and other business men with detailed information in regard to Venezuelan markets, and desires to receive catalogs and other literature from American business houses.

Report of Observers on Air-Naval Experiments

The joint board appointed by the Secretary of the Navy has submitted a report on the results of the aviation and ordnance experiments held during June and July, 1921. The experiments were made with the aid of the ex-German war vessels alloted to the U. S. by the Versailles Treaty.

The experiments definitely determined in each case that the projectiles used were superior to the defensive features of construction of the vessel attacked. It has long been recognized that the gun carried by any type of war vessel is superior at moderate ranges to the armor or protective construction of vessels of like type. In a large measure, therefore, the greatest interest in these experiments lay in the bombing of naval vessels by aircraft. The main features of this report, therefore, relate to the effectiveness of aircraft in offensive action against various types of naval vessels.

In the present state of anti-aircraft defense it is believed that, if an air force can obtain the mastery of the air, an effective percentage of hits can be obtained against surface vessels coming within the radius of action of bombing planes without an undue percentage of loss of aircraft. The history of war indicates that means of defense develope rapidly to meet the development of offensive weapons. The effectiveness of the bomb carried by aircraft emphasizes the necessity for the rapid development of anti-aircraft armament and for the provision of pursuit planes as a part of the fleet.

The aviation and ordnance experiments conducted with the ex-German vessels as targets have proved that it has become imperative as a matter of national defense to provide for the maximum possible development of aviation in both the Army and Navy. They have proved also the necessity for aircraft carriers of the maximum size and speed to supply our fleet with the offensive and defensive power which aircraft provides, within their radius of action, as an effective adjunct of the fleet. It is likewise essential that effective anti-aircraft armament be developed.

The joint board also recommended that the provisions of the previous orders of the War and Navy Departments relative to secrecy concerning the results of the aviation and ordnance experiments be rescinded and that the report, if approved by the War and Navy Departments, be issued jointly to the press. The report is signed by General John J. Pershing, as senior member

Three Auto Builders Cut Prices

A third cut in prices, announced in Detroit last week by the producers of Hudson and Essex automobiles, puts these well-known models at lower prices than they have ever sold for.

The Hudson super-six was in great demand last year and sold at $2,600. The new price is $1,895.

The Essex price last year was $1,795. It now is $1,375. These prices refer to open touring models. Similar reductions have been made on all models.

Officials of the two companies state that heavy sales during the summer have exhausted old inventories, reduced overhead costs and that they are now able to buy materials at new low costs.

King Motor Car Co. has announced its 1922 prices, which are $600 lower on open models and $800 lower on closed models. Costs are: Touring and foursome, $2,125; roadster, $2,140; coupe, $3,125, and sedan, $3,234.

Auto Race Feature of Steel Treaters' Convention

George Desautels, chairman of the entertainment committee of the convention and exhibition of the American Society for Steel Treating, to be held in Indianapolis, Sept. 19 to 24, has announced a match race between Frontenac and Duesenberg automobiles.

This 50-mile race will be staged on the speedway, Wednesday morning, Sept. 21, at 10 a.m.

There will be three or four Frontenac cars and three Duesenberg machines.

These two manufacturers of racing cars are located in Indianapolis, and are great rivals, and it will be a wonderful race in as much as both firms are particularly anxious to secure the valuable trophy which will be presented to the winner.

Mr. Duesenberg has also agreed to stage an exhibition with his special car which has made a record of 156 miles per hour.

It is also possible that "Jimmie" Murphy and his car in which he won the Grand Prix in France, will be in Indianapolis and enter the race that is being staged for the benefit of the visitors and delegates to the steel treaters' convention.

While the race will probably be the largest event, and probably of greatest interest to the visitors, Mr. Desautels has arranged for golf tournaments, tennis tournaments, and ball games between the Eastern and Western delegates. Dances, smokers, vaudeville, and a continual round of enjoyment are promised for the visitors.

Fokker to Build Passenger Planes in America

The Netherlands Aircraft Manufacturing Co. announces that it will shortly commence the manufacturing of Fokker machines of all types in this country. Anthony H. G. Fokker, whose machines are now carrying passengers on every airway in Europe, said when he visited this country recently that he regarded the United States as the most fertile field for aircraft exploitation, and signified his intention of invading the American field as soon as his European contracts would allow. The Fokker limousine, 5-passenger monoplane, is the first of the ships he has sent here to make good his promise. The fact that the limousine is a monoplane, with the wing high above the carriage, allows passengers an uninterrupted view when in flight. The wing, which is more than two feet thick, is built on the cantilever principle, and needs no struts or guys to support the carriage. This limousine is the most advanced type of passenger-carrying airplane. Arrangements have been made by the officials of the Netherlands company for a series of flights out of New York. One of the first of these will be a non-stop trip to Washington, where the machine will be demonstrated for the benefit of government officials.

China Buys Rails in Tennessee

The Chinese government has placed an order with the Tennessee Coal, Iron and Railroad Co. at Birmingham, Ala., for 13,000 tons of steel rails for the Pekin Huanhan railroad. The rails are to be shipped from the port of Mobile as soon as possible. An order was received from China some time ago by the Tennessee company for 12,000 tons of steel rails for the Manchurian railroad.

The Business Barometer

This Week's Outlook in Commerce, Finance, Agriculture and Industry Based on Current Developments

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

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The outlook seems anomalous and is confusing. It reminds one of the changeable pictures sometimes used to advertise a toothache cure. From one angle a face in agony is to be seen; from another a smiling countenance is revealed. Commerce is undoubtedly improving but finance is depressed. The sequence is unusual. Formerly is was reversed.

The security dealers and bankers have always boasted that they could see farther ahead than the merchants and have been the first to sense a recovery in general business. Now the improvement in business is upon us but the stock exchange is still discouraged, and bankers, though they talk bravely, are acting with grave caution if not timidity. Wall Street in particular is blue, probably because the shores of its maelstrom are strewn with the wreckage of the recently rich who had come to think themselves invulnerable to the slings and arrows of outrageous fortune. Some who called themselves bankers are in this chastened class, for it seems that no one was entirely immune to the speculative contagion which swept over the world after the armistice. An idea of what it cost its victims can be had from a comparison between the high prices of 1920 and current quotations for a long list of industrial stocks. Some of them have declined more than $100 per share and the total depreciation runs into the billions.

But the chief sufferers by this decline are those who made paper profits during the war, and while their grief naturally affects those with whom they associate, the nation's wealth, as measured in things rather than money, is not reduced by their losses.

The depression in Wall Street may also be partially attributable to the unsettlement abroad upon which I commented last week. De Valera's reply to the English proposals seems truculent and defiant, but the statement that "the Dail Eireann is ready to appoint representatives to negotiate on the basis of government by the consent of the governed" is construed by some as indicating a willingness to parley further, and as those who are willing to parley generally make peace there may still be some hope of a settlement. As bearing upon Britain's other problems it is worth noting that Lord Milner made a speech in London on Aug. 23 in which he advocated an Imperial Parliament and a written constitution for the Empire, while on the very same day the cables brought news of a serious uprising in the Malabar district of British East India, where an "open rebellion" was reported.

In Germany bankers are said to be disturbed by the rapid fall in the purchasing power of the mark at home as well as abroad and the Reichsbank last week reported a sudden reduction of over 9,000,000,000 marks in the outstanding paper currency. This is probably due to the collection of taxes in which case the paper money taken in will soon be issued again. The contraction is otherwise inexplicable though it might have been accomplished by some unreported issue of government securities through which the currency paid in would have been temporarily retired. In this connection Secretary Hoover's warning to American buyers of German municipal securities should be mentioned. He points out that many German cities have already issued bonds payable in marks for sums that would be fantastically large and impossible of repayment if the mark recovered its gold value. From this it is to be inferred that he doubts any such recovery.

The Brighter Side

I have purposely grouped together all the financial depressants that are discernible, bringing them into relief that they may be weighed against the much longer list of the week's encouraging developments.

There is first the statement of the Federal Reserve system which shows a gain of $19,000,000 in the gold reserves and a reserve ratio of 66.5 as against 65.8 per cent the week previous. On these figures a further reduction in the rediscount rate is generally expected and the money market is informally easier though relatively high rates are still asked of impecunious borrowers. Then there is the sensational advance in cotton caused by the sensational reports of crop failure plus the fanciful suggestion of the American Cotton Association that the legislatures of the cotton states should prohibit planting cotton altogether in 1922 so that the boll weevil and the boll worm having nothing to feed upon would be finally eradicated.

The proposal is, of course, impossible, as the cure would be worse than the disease, but it is "a good enough Morgan until after the election" and it may be that cotton will be carried much higher, for the prospectve crop, plus the much exploited surplus, is not in excess of the prospective demand and will be rather insufficient if there is an economic recovery in Europe. The advance is, of course, benefiting the South where it is thawing out much frozen credit. But it is, however, even more important as evidencing a return of the speculative spirit which, much as it may be deplored by some, is always a noncomitant of the psychological condition that is called prosperity.

The *Coal Age* says that "there is unmistakable evidence of a quickening inquiry" for coal and that the turn seems to have come. As a generalization the same thing may be said of iron and steel for the steel corporation has cut prices again, and the *Iron Age* reports a slowly expending demand for some forms of steel. This is reflected by an advance in the price of pig iron, which is up $2 a ton. The well informed men in the steel trade expect an active business in September.

The demand for building material is better, at least in the New York district, and brick, lath and flooring are being freely bought. Despite the alleged unemployment, the *New York Times* reports a shortage of bricklayers, plasterers and carpenters.

The export movement of wheat is increasing. The cash demand is excellent and while prices are not yet much higher the bullish feeling in the grain market is becoming more pronounced and a sharp upward movement would not be surprising.

Bank clearings (Bradstreet's)	End of Last Week	End of Previous Week	Last Year
In thousands	$5,148,361	$5,817,771	$7,081,248
Business failures	395	376	133
Security prices, N. Y. Stock Exchange:			
20 Industrials	63 91	65.96	87.22
20 Railroads	70 21	72.28	76.55
40 Bonds	77 62	77.62	74.00
Commodity prices:			
Wheat, No. 1 spring	$1.66½	$1.59½	$2.75
Corn, No. 2 yellow	.74½	.73¾	1.80
Beef, good dressed steers	15 00	15.25	24.50
Pork, mess, bbl.	25 00	26.00	32.50
Sugar, refined	.0580	.0615	.17
Coffee, Rio No. 7	07	.07¼	.08¼
Cotton, middling	1530	.1300	.3350
Print cloths	04½	.04¼	.12
Wool, domestic average	3988	.4173	.70
Silk No. 1, Sinshiu	5 55	5 70	5.60
Rubber, crude, plant	14	.14	.30
Hides, pack. No. 1	14	.14	28
Iron, No. 2, Phila.	20 34	20.34	50.50
Steel billets	30 00	30 00	60.00

The encouraging report of the facts thus assembled seems to have been appreciated by those who have written the various trade reviews published during the week. The Irving National Bank of New York says that the outlook for renewed business activity is brighter than for some time and the First National Bank of Boston and the Merchants National Bank of that city are substantially in agreement with this view.

Fall Trade Coming

A careful survey of the dry goods and grocery trades made by the *Journal of Commerce* reveals minimum stocks, complete liquidation, bare shelves, easier credits, an under supply with advancing prices for canned goods and "evidence everywhere of a promising fall trade" while "the tone of public sentiment is optimistic with scarcely an exception."

My correspondents on the Pacific coast are equally optimistic. From Seattle a large increase in jobbing business is reported. "The lumber trade is improving on the demand from Japan, where six of the principal cities are to be rebuilt on American lines entailing a steady lumber order for 100,000,000 ft. during the next three years." "Australia and New Zealand are cabling that wool and wheat credits are being re-established in London and that they will want lumber in large quantities soon, while there is an eager demand from everywhere for the product of our canneries."

Throughout the United States the railroad traffic is increasing, the number of idle cars is decreasing and net earnings are improving. Net revenue for June was $67,000,000 against a deficit of $15,000,000 last year. Congress has adjourned without voting the roads the $500,000,000 for which they asked. Opposition to the grant is increasing and it may not be made, for public sympathy with the carriers has been somewhat cooled by Mr. McAdoo's analysis of the claims made for alleged inefficiency of labor during Government control. It is possible that the roads will be able to get along without it and strengthened by the self denial they will have to practice, for easy money is rarely good for any one.

The savings banks in the State of New York report a gain of $249,000,000 in deposits for the year ending June 30, 1921. As only $93,000,000 of this was interest some people must be making more than they spend.

A high commission of the American oil industry, headed by Mr. Teagle of the Standard and Mr. Doheny of the Mexican Petroleum, has gone to Mexico to confer with President Obregon. Conjecture is busy as to the purpose and result of the meeting but it is probably safe to assume that it will develop a mutuality of interest between Obregon and oil. Peace treaties with Austria and Germany have been signed during the week. As each must be ratified by the U. S. Senate and the legislative branch of the assenting European government, neither will become effective for some time. Foreign exchange has been steadier, reflecting, so it is stated, the constant though quiet absorption of South American and Canadian securities by American investors.

The account current of the week's news as above stated appears to have a handsome balance on the credit side and the only thing that appears to stand in the way of a national business revival is the "hang over" from which Wall Street is suffering as a result of its speculative debauch in 1920. Fortunately these "morning after" headaches are never fatal and young nations like young men soon recover from them.

Death of Percy M. Fowl

Percy M. Fowl, president and general manager of the Cadillac Tool Co., Detroit, Mich., died last week. He was also president of the Detroit Garage Equipment Co., and president of the Household Utilities Corporation. Full obituary notice will appear in our next issue.

French Machinery Imports and Exports

SPECIAL CORRESPONDENCE

During the year 1920 France imported 516,965 metric quintals (a metric quintal equals 50 kilograms, approximately 100 pounds) of agricultural machinery, while the exports in the same line amounted to 58,362 quintals.

The imports of machine tools amounted during the same year to 569,406 metric quintals, as against only 73,037 quintals representing the exports. The chief items of importation in the machine tool line were the following: Turning lathes, 166,620 quintals; planing lathes, 45,460; drilling machines, 40,830; milling machines, 42,840; steam hammers, 25,290; presses, 24,010; circular saws, 33,480; metal shears, 17,040; vises, 14,170; chisels, 12,950; drills, 9,840; sawing machines, 8,720; bending machines, 8,520; straightening machines, 7,240; adjusting machines, 6,440; rolling mills, 6,270; punching machines, 6,220; woodworking machines, 5,460; grinding machines, 5,300; wire-drawing machines, 4,570; forging machines, 4,560; cog-wheel machinery, 4,340; followed then by smaller amounts of riveting, screw-cutting, polishing, metal-dressing, perforating, and other kinds of machines.

Chinese Demand for Machinery

American manufacturers should pay close attention to the possibilities offered by the Chinese market. In 1913 the total imports of machines into China amounted in value to 4.6 million taels and in 1920 to 22.3 million taels. Especially the demand for all kinds of electrical machinery is considerable and is steadily increasing. Already in 1911 towns with a population of scarcely 30,000 souls were in possession of an electric light plant, and this was especially the case in the south of the country. The demand for railway rolling stock, the importation of which had almost entirely ceased during the war, is also very great.

Experiment Station at Tuscaloosa

The Southern experiment station of the Bureau of Mines is to begin its research work in the immediate future, it is announced by officials of the Department of the Interior. The station is located at Tuscaloosa, Ala., and has been virtually completed save for the installation of special equipment.

The station will devote its primary attention to research problems in iron ore ranging from the crude ore to the finished pig iron; by-products in their relation to blast furnace working of local ores; and the study of mineral fillers.

The mineral fillers study will be an important part of the work to be carried out on account of the special resources of the South in non-metallics. Fillers for paints, paper, rubber goods and fabrics will be studied in order to find some suitable material among these resources.

Creusot Firm to Build Machinery for French Markets

In a Paris journal, Eugene Schneider, head of the great Creusot works, has stated that German inroads on the French electrical industry are becoming more and more apparent and that prices for electrical machinery from Germany are, in general, 50 per cent lower than the same product of French manufacture. Continuing, he said:

"The Schneider firm at Le Creusot is making great preparations in its various plants to meet the need for electrical appliances in the French market."

This is virtually a new phase of this versatile French metallurgic firm. Mr. Schneider stated, also, that during a period of 30 years no strike has occurred at the Creusot works, that relations with their workmen are always of the best and that the elder Schneider, two generations removed, first established industrial and manual training schools in connection with the business so long ago that what is today called a modern idea is something that had been known in France for 40 years.

Exports of Sugar-Mill Machinery to Cuba

That Cuba expended a portion at least of its war profits in providing for increased production of sugar is shown by the large increases in the exports of sugar mill machinery from the United States to that island, since 1915. The following figures have been compiled from the records of the Bureau of Foreign and Domestic Commerce:

Exports of sugar-mill machinery to Cuba

Year	Dollars
1911	1,252 647
1912	1,075,991
1913	1,382,959
1914	1,026,453
1915	1,320,246
1916	5 179,987
1917	9,121,512
1918	8,558,992
1919	7,385,602
1920	13,805,373
For the six months ending June 30, 1921	7,269,465

American Machinery to Palestine

The first shipment of tools to the workers in Palestine was dispatched by the Palestine Tool Committee on the steamship City of York, which sailed for Jaffa on Aug. 18. A delegation accompanied the vessel on an excursion boat down the bay to wish bon voyage to the three mechanics, P. Irsbofsky, M. L. Kasselmen and William Rosen, who will look after the cargo of tools and machinery when the vessel arrives at Jaffa. The shipment consists of a complete road-making unit, several hundred pieces of agricultural machinery; complete equipment for a woodworking shop and a lot of blacksmith's tools, shoe repairing machinery, sewing machines and other tools.

EXPORTS OF METAL-WORKING MACHINERY, AS REPORTED BY THE DEPARTMENT OF COMMERCE FOR JULY, 1921, AND THE FIGURES FOR JULY, 1920, AS FINALLY REVISED, ARE AS FOLLOWS:

While July exports of metal-working machinery show some increase over the poor showing in June, they fall far below the value of this type of machinery exported in July, of 1920. The Bureau of Foreign and Domestic Commerce has just made public its figures for July, 1921, and the revised figures for July, 1920. The value of all exports of metal-working machinery during July, of this year, was $1,734,495. The details are shown by the following table:

	July, 1920	July, 1921
Metal-working machinery	$542,175	$191,983
Lathes	542,175	191,983
Other machine tools	915,074	281,936
Sharpening and grinding machines	396,246	105,293
All other	1,823,097	1,155,283
Total metal-working machinery	3,676,592	1,734,495
Exported to:		
Belgium	64,585	20,366
France	978,634	864,201
Italy	52,415	4,673
Norway	5,508	582
Spain	44,643	19,307
Sweden	32,303	572
United Kingdom	937,077	221,695
Canada	548,653	54,296
Mexico	44,438	68,275
Cuba	37,659	36,776
Brazil	16,131	10,145
Chile	15,948	13,016
China	36,294	1,251
British India	225,347	175,478
Japan	300,899	129,291
Australia	32,688	8,494
Netherlands	.....	8,147
Argentina	.....	7,542
Dutch E. Indies	.....	1,135
Other countries	303,370	88,983

Business Items

The agency arrangement for the sale of sheet steel heretofore existing between Thomas Firth & Sons, Ltd., of Sheffield, England, and Wheelock Lovejoy & Co., of New York and Cambridge, has been terminated. Thomas Firth & Sons have appointed as their general sales manager for the United States, Horace G. Hides, of Hartford, Conn. The stock of Firth Sheffield sheets will be carried in the warehouse of the Firth-Sterling Steel Co., 312 Hudson St., New York City. Thomas Firth & Sons and the Firth-Sterling Steel Co. are also opening a joint office in Hartford, Conn., where Mr. Hides will have his headquarters and where Henry I. Moore will represent the Firth-Sterling Steel Co.

The Hampton Roads Equipment Co., Inc., 251-252 Arcade Building, Norfolk, Va., has been incorporated with $150,000 capital stock to act as representative to manufacturers of conveying machinery, contractors' supplies, etc. J. M. Sherrod is president, B. P. Bears, vice-president, and W. L. Duncan, secretary-treasurer and general manager.

The Metal Products Co., Youngstown, Ohio, has been incorporated with an authorized capitalization of $50,000. The incorporators are F. R. Weinreich, W. F. Ullman and others. The business will consist of the preparation and sale of metals of various descriptions.

Reeves Pulley Co., Columbus, Ind., announces that arrangements have been made with Manning, Maxwell & Moore, Inc., of 119 W. Fortieth St., New York City, whereby the latter assumes the exclusive agency for "The Reeves" variable speed transmission in the New York territory. Manning, Maxwell & Moore will carry a complete assortment of repair parts for these transmissions as well as "The Reeves" wood split pulley.

The Lumen Bearing Co., of Buffalo, N. Y., and Youngstown, Ohio manufacturer of "machine bronze" brass and bronze castings and bearings, solders and babbitts has established a branch office in Chicago that will supply and handle all business of the company west of and including Michigan with the exception of the city of Detroit; west of a line from Toledo, to Columbus to Cincinnati; Kentucky, Tennessee and Georgia. H. S. Huncke is the Western sales manager, with Henry Waters as associate salesman. The new office is located at 15 No. Jefferson St., Chicago.

A schedule of assets and liabilities was filed in the federal court on Aug. 9, by the bankrupt Kenworthy Motors Corporation, of Mishawaka, Ind., showing assets amounting to $124,433.38, and liabilities amounting to $174,859.49. The concern recently admitted bankruptcy in answer to a creditors' petition, filed against it on July 11 by the Auto Cape Top Co., the Western Brass Manufacturing Works, of Chicago, and the Cleveland Pneumatic Tool Co. The Kenworthy corporation lists its excise tax due on automobile sales at $6,980.77, and open accounts at $119,652.14. Of the assets $40,000 is in real estate and $65,683.28 is in stock in trade.

The Fitch Vending Machine Co., Inc., Buchanan, Va., has been incorporated with $15,000 capital stock. J. F. Fitch, is president, A. B. Land, secretary and O. E. Obenshain, treasurer. The company will contract for the manufacture of vending machine parts but will assemble the machines and manufacture cabinets at its own plant.

Southern Pacific Railroad is reported to have offered independent oil refiners in north Texas field any part of 500 tank cars each without charge, provided oil is shipped over company's lines. Idle tank cars in United States are said to number about 40,000.

Erie railroad is reported to have leased its shops at Marion, O., to a service company organized by local manufacturers, bankers and business men, and has given contracts for its repair work to the new corporation, which, it is believed, will not be subject to rules of Railroad Labor Board.

The Dodge Sales and Engineering Co., of Mishawaka, Ind., announces that the construction of its new million-dollar building at 49 Park Place, New York City, has been started. The products of the company include pulleys, rope drives, hangers, shafting, bearings, couplings and heavy oil engines.

The Osgood Bradley Car Co., with factories at Worcester, Mass., has recently been awarded the contract to build twenty-two electric cars for the electric zone between New York City and New Haven, Conn., for the New York, New Haven & Hartford Railroad Co. The cost is estimated at $1,400,000. Officials of the Bradley company announce that eight hundred employes will be given work on this order for the balance of the year.

The Aircraft Construction Corporation of New Haven, Conn., has been incorporated under the state laws of Delaware with a capital stock of $100,000,000. Charles B. Bishop, Samuel H. Baynard, Jr., and A. S. Bishop are named as incorporators. The business of the company will include principally general construction and transportation of aircraft.

The Gould Machinery Co., 232 East 74th St., New York City, has been organized by Herman Gould, formerly with the Latham Machine Co. The new concern will conduct a maintenance and repair business for bookbinding, printing and boxmaking machinery.

The Enterprise Foundry and Machine Works, Bristol, Tenn., manufacturer of roller bearing trucks for mine and industrial railways, is now extending its facilities for the manufacture of complete mine cars.

Sidney Thompson, president of the Defiance Screw Machine Products Co., Defiance, Ohio, has taken over the Napoleon Tool and Machine Co., increasing its capitalization from $40,000 to $50,000 and changing its name to the Napoleon Products Co. Automobile parts will be manufactured under the new management.

Operations of a part of the Bucyrus Machine Tool Co.'s plant at Bucyrus, Ohio, as a general machine and repair shop, is to be undertaken shortly by G. P. Young and A. W. Wheeler. Arrangements have been made with the receivers for the company which closed sometime ago after its operation by the Browarsky-Crumm Manufacturing Co. Mr. Wheeler has been manager of the Galion Iron Works, Galion, Ohio, and before that was superintendent of the Allen Motor Co., of Bucyrus. Mr. Young was with the Hadfield-Penfield Steel Co.

Charles S. McKinley, assistant manager of sales of the Republic Iron and Steel Co. at the Youngstown Ohio, office, has resigned to become associated with his brother, A. E. McKinley, an instructor in the University of Pennsylvania, in the management of the McKinley Publishing Co., Philadelphia. He had been with the Republic company since 1913, coming here from Pittsburgh where he had been manager of sales in that district. He will be succeeded by Walter H. Hall of the Pittsburgh office of the Republic Iron and Steel Co. Mr. Hall will be located at the Youngstown office.

Personals

Nels B. Lund, a pioneer in the design of aircraft instruments and gyroscopic apparatus and formerly with the Sperry Gyroscope Co., Brooklyn, N. Y., has become associated with the Pioneer Instrument Co., of Brooklyn, N. Y., as assistant to chief engineer M. M. Titterington.

Joseph A. Horne, vice-president of the Yale & Towne Manufacturing Co., of Stamford, Conn., sailed for Europe on Aug. 23 and expects to return in October. His object is to make a careful study of business conditions in Great Britain and on the Continent.

W. C. Reilly, general superintendent of the Youngstown Sheet and Tube Co., Youngstown, Ohio, is in Halifax where he had been called as an expert appraiser in a controversy between the Dominion Steel Company and the Nova Scotia Provincial Government. The controversy, which arose from war contracts, is said to involve claims of $9,000,000.

The W. A. Jones Foundry & Machine Co., Chicago, Ill., announces the appointment of Robert B. Moir as manager of the New York branch. He will assume his new duties immediately, making headquarters at the present sales office and transmission warehouse of the company at 20 Murray St. Mr. Moir has been actively connected with the home office and factory for a number of years.

Trade Catalogs

Auto Trestles. The Manley Manufacturing Co., York, Pa. Catalog No. 300, describing the Manley floor level under-worker auto trestle for elevating the front or rear end of a car to work on the under parts of the chassis.

Electric Furnaces. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa. The new line of electric furnaces which has recently been added to the products of this firm is described and illustrated in catalog 9-C, which is being distributed. This type of furnace includes the multiple unit designed for use with heats of 1800 to 2000° F. The small Hevi-duty furnaces of the multiple crucible type may be operated continuously at 2000° F. Hevi-duty industrial furnaces with applications for annealing, hardening, drawing and enameling, are described in minute detail in this publication. A discussion of the characteristics of these furnaces is also given.

Jarvis Tapping Device. The Geometric Tool Co., New Haven, Conn. Catalog describing a high-speed tapping device, quick-change chucks and collets.

Pease Blueprinting Machine. C. F Pease Co., Chicago, Ill. A circular describing and illustrating the Pease "Peerless" automatic blueprinting, washing and drying machine.

The Iron Man. Pearson-Scott Co., Indianapolis, Ind. Catalog illustrating and describing a mechanical device known as "The Iron Man" which is an attachment for use with hand screw machines or turret lathes, taking the place of an operator.

"Little David" Pneumatic Tool Accessories. Ingersoll-Rand Co., 11 Broadway, New York. A twenty-four page catalog describing and illustrating air hose, hose couplings, hose clamps, drill chucks, chisels and chisel blanks, rivet sets and blanks, wire brushes, oils and greases, rail bonding drills, rail drills and railroad kit boxes.

Milling Machines. Ingersoll Milling Machine Co., Rockford, Ill. Circular illustrating and describing a circular Ingersoll continuous milling machine with which the bottom surfaces of the upper crankcases of a four-cylinder motor is milled.

Bath Micrometer and Master Ring. John Bath & Co., Inc., Worcester, Mass. Describing a new type of measuring tool. It can easily be set to conform to any existing shop standard, or adjusted to correct standard size by resetting the graduated ring and is available in U. S. Standard and S. A. E. Standard sizes.

Catalogs Wanted

J. Worner & Co., Budapest, Hungary, would be pleased to receive catalogs on flour milling machines and equipment, printing presses and coal pulverizing machines. This company serves an extensive clientele in Hungary, the Balkan States and Russia. Until Sept. 20 all catalogs should be sent care of L. J. Calder, 348 Madison Ave., New York City; thereafter to the firm's home address.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

A mercantile company in South Africa desires to purchase pipe threading and cutting machines, pipe fitting and tapping machines, socket making and tapping machinery, bending presses and bend-threading machinery. This machinery is urgently needed and will probably be ordered by cable. Reference No. 35314.

A manufacturing firm in Switzerland desires to secure an agency, or purchase on own account, bright polished, hardened and tempered heddle steel, with rounded edges, sizes: 11 by 0.2 millimeters; 12 by 0.2 millimeters; and 10.8 by 0.2 millimeters; polished, hardened and tempered, yellow or blue, gramophone spring steel; clock spring wheel; and heald wire. Quotations should be given c.i.f. Antwerp. Terms: 30 days monthly account. Reference No. 35329.

An American citizen with offices established in Hungary desires to secure representation of firms for the sale throughout all the Balkan States of adding and calculating machines; typewriters; automobiles and supplies; automobile tires; agricultural machinery and implements; trucks and tractors; fertilizers; and tin plate: Terms: Cash on delivery. Quotations: C.i.f. European port, preferably Trieste. Sample lines to be forwarded when possible, and in every case catalogs, price lists and details as to terms, etc., should be given in first letter. Reference No. 35349.

A commercial agency firm in Jugoslavia desires to purchase and secure an agency for the sale of cultivation and harvesting machinery for use with tractor. Quotations should be given c.i.f. Trieste, or f.o.b. New York, preferably the former. Payment: Cash against documents in New York or Trieste in United States currency. Reference No. 35353.

A mercantile company in Southwest Mexico desires to purchase large quantities of hardware and machinery for machine shops, tools, car-repair materials and in general a supply of all material used in building a harbor. Quotations should be given c.i.f. Mexican port, or f.o.b. point of shipment. Reference No. 35354.

Obituary

Peter Cooper Hewitt, American scientist and inventor, died in the American Hospital, Paris, on Aug. 25. He was sixty years old. He was best known in the scientific world for his invention of the "Cooper-Hewitt Lamp," which is in common use throughout the world, and the Cooper-Hewitt Rectifier," by which direct current machinery can be used when only alternating current is available. He was also deeply interested in the study of aeronautics, having made extensive experiments with hydroplanes. During the war he was made first vice-chairman of the United States Naval Consulting Board and rendered valuable service to the country. He was a member of many technical societies including the American Institute of Electrical Engineers, American Physical Society, Society of Naval Architects and Marine Engineers, New York Society of Electrical Engineers and the General Society of Mechanics and Tradesmen.

Col. Samuel P. Colt, chairman of the board of the United States Rubber Co., died at his home in Bristol, Conn., on Aug. 13. He was in his seventieth year.

Forthcoming Meetings

The second International Cost Conference will be held at Cleveland, Ohio, on Sept. 14, 15 and 16, under the auspices of the National Association of Cost Accountants.

The third annual convention and exhibition of the American Society for Steel Treating will be held in the Manufacturers Building, State Fair Grounds, Indianapolis, Ind., during the week of September 19 to 24 inclusive.

The annual congress of the National Safety Council will be held at Boston, Mass., during the week of September 26. C. W. Price, 168 North Michigan Ave., Chicago, Ill., is general manager.

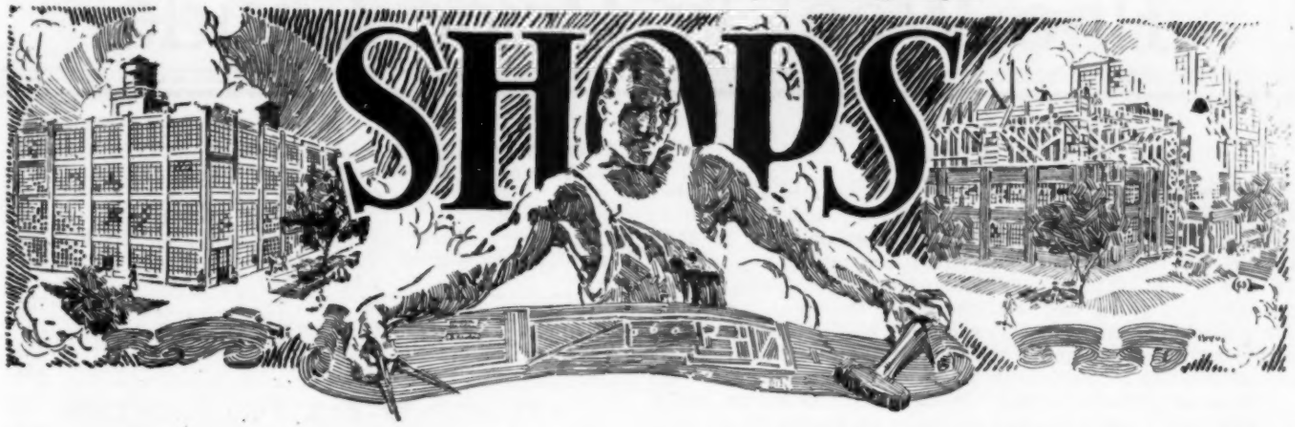
The twelfth annual convention of the American Manufacturers Export Association will be held in the Waldorf-Astoria Hotel, New York City, on October 5 and 6. A. W. Willmann is secretary.

A joint meeting of the American Society of Mechanical Engineers, the Society of Automotive Engineers and the Army Ordnance Association will be held at Aberdeen, Md., Friday, October 7.

The American Gear Manufacturers Association will hold its semi-annual meeting at Rochester, N. Y., October 13, 14 and 15. F. D. Hamlin, 4401 Germantown Ave. Philadelphia, Pa. is secretary.

The National Machine Tool Builders' Association will hold its fall meeting at the Hotel Astor, New York City, October 18, 19 and 20.

NEW *and* ENLARGED



Machine Tools and Machinery Wanted

Machine-tool wants published without charge

N. J., Jersey City—motor driven shear for cutting off round iron, up to 1¼ in. dia. and arranged for 440 volts, 2 phase A.C. or 110 volts, 1 phase A.C.

N. Y., New Haven—A. A. Hamlin—One 36- or 42-in. veneer lathe.

N. Y., New York—Nielsen & Winthers, 59 Pearl St.—Lennox type rotary level shear for ¾ in. plate.

Pa., Philadelphia—The Bureau of Water, 792 City Hall—Contract 518—machine tools for repair shops. Contract 523—one electric crane for Shawmut Pump station.

Pa., Pittsburgh—F. A. French, Braddock Ave. and Guthrie St.—No. 10 Brown & Sharpe type grinding machine or similar (used).

Va., Richmond—Anderson & Childress, 1605 West Broad St.—drill and arbor presses, emery wheel, medium size lathe, air pump for auto repair shop (used; in good condition).

Va., Wytheville—R. P. Johnson, O. M. Johnson, Purch. Agt.—Hays or Jenkins double end tenoner for machine shop.

W. Va., Raiville—The Sewell Valley R.R. Co.—one 1,200 lb. steam hammer, 20 in. engine lathe with power cross feed and taper attachment to swing 8 ft. between centers or same turret type, with turret on carriage, belt driven, one No. 2 or 3 universal milling machine, belt driven, a 24 in. high speed upright drilling machine back geared, belt driven, a 58 or 68 in., 250 ton wheel press, inclinable type, belt driven and a 60 in. driven lathe to turn straight connectors, belt driven, also 2 Shay type drivers.

Ill., Chicago—The Chicago Metal Mfg. Co., 216 West Ontario St.—one 10 ft. power shear, 10 or 12 gage.

Ill., Chicago—E. M. Heller Co., 144 West Kinzie St.—two Hoeffler piston boring machines, 20 in. x 14 ft. bed lathe.

Ill., Chicago—Atchison, Topeka & Santa Fe R.R., Railway Exchange Bldg., M. J. Collins, Purch. Agt.—One vertical boring mill, heavy duty type, 76 in. swing, 2 heads on cross rail, swiveling type. Proposition wanted also on alternates, one with 84 in. swing and one with 100 in. swing.

One double end car wheel axle lathe, heavy duty type, 52 in. swing, complete with bushings for standard size axles, calipering attachments, set of centers for engine truck wheels (inside journals) and complete with all required dogs.

One vertical drilling machine, sensitive type, heavy duty, capacity 1¼ in. in steel, reach 18 in. drill to column, belt driven through gear box, single pulley driven preferred.

One car wheel journal truing machine with all usual attachments, motor driven.

One radial drill press, heavy duty type, 5 ft. swing, belt driven through gear box with single pulley drive.

One engine lathe, belt driven, heavy duty type, 36 in. swing over bed, compound steady and follower rests quick change gear, taper attachments complete with all steel chucks with independent steel jaws fitted to lathe. Also give propositions on several types of back gears, bidders, makes, geared head and lathes as above but with 42 in. and 48 in. swing respectively.

One engine lathe, belt driven, heavy duty type, compound steady and follower rests, quick change gear, taper attachments complete with all steel chuck with independent steel jaws fitted to lathe. Also give propositions on several types of back gears, bidders, makes and geared head and lathes as above but with 30 in. and 36 in. swing respectively.

Mich., Detroit—L. Spinks, 6083 Vermont Ave.—lathe with 1¼ in. hollow spindle and chuck.

O., Canton—McKinley High School will receive bids about Sept. 16 for machine shop equipment. Former bids rejected. Noted July 28.

O., Cleveland—Chesterfield Junior High School, Durant and East 117th Sts.—equipment for machine shop.

Wis., Milwaukee—Auto Mutual Service Co., 531 Grand Ave., A. De Pierre, Purch. Agt.—lathe and drill press.

Wis., Milwaukee—Joe's Garage, 684 3rd Ave.—drill press to drill 1 in. hole.

Wis., Oshkosh—Kaerwer Auto Co.,—machine and power machinery including lathes, presses, etc.

Md., Baltimore—The Western Maryland Dairy Co., Linden and Dolphin Sts., A. B. Gardner, Pres.—$250,000 worth of refrigeration machinery.

N. Y., Buffalo—A. D. Cutting Co., 1170 Jefferson St., A. D. Cutting, Purch. Agt.—mortise machines.

N. Y., Buffalo—Duffy Silk Co., 1270 Bway., C. Duffy, Owner—equipment for proposed silk mill.

N. Y., Highland—D. H. Starr & Son, Vineyard Ave.—Saw bench with tipping table 39 x 48 in.

Rip saw.

Complete Post Borer with one self centering chuck to hold drill shanks up to 1¼ in. dia.

One automatic knife grinder.

One Wheland railroad cut-off saw.

One straight frame saw mandrel.

Pa., Phila.—Tazewell Mfg. Co., Tazewell, Va.—bottling equipment, for proposed plant here.

Pa., York—The Reed Machine Co., 231 North George St.—machinery.

Fla., Ft. Myers—The Florida Doll Mfg. Co., B. F. Roessling, Purch. Agt.—machinery for use in manufacture of toys, including automatic lathe to turn out doll bodies, legs, arms and heads, presses to manufacture heads by the die process, mixing machinery to mix composition for doll heads, paint spraying outfits, etc.

Fla., South Jacksonville—The South Side Concrete Co.—all kinds of concrete machinery.

S. C., Hartsville—F. D. Slaght—bakery equipment, including dough mixer, cake mixer, etc.

S. C., Spartanburg—B. G. Sanders—complete baking machinery and other equipment.

Tenn., Chattanooga—The Cumberland Oil Co., 8½ West 8th St., E. B. Clark, Mgr.—complete oil drilling machinery.

Va., Richmond—J. W. Montgomery, mill work, 1716 West Cary St.—mortising machinery, belt sander and combination rip saw.

Va., Richmond—E. K. Vieter, 1800 Simms Ave., manufacturers of tobacco, W. F. Lee, Purch. Agt.—Complete line of drying machinery operated by motors.

Wis., Hartford—Portz Bros. Malt & Grain Co.—special machinery, cooking apparatus, etc., for proposed plant.

Wis., Hawkins—The Northern Sash & Door Co., J. Jesdahl, Purch. Agt.—woodworking machinery including sticker and planer, etc.

Wis., Menasha—United Paper Corp., c/o J. S. Frankland, Pres.—machinery, etc., for proposed paper factory.

Wis., Milwaukee—Acme Grey Iron Fdry. Co., 470 37th St., C. W. Brown, Purch. Agt.—foundry equipment.

Wis., Milwaukee—The Red Star Yeast Co., 79 Buffalo St.—conveying machinery.

Wis., Milwaukee—Rosenberg Elevator Co., 174 Reed St.—one 5 ton traveling crane.

Wis., Neenah—E. A. Wettengel, 578 Pierce Ave., Appleton—two paper machines, 8 beaters and washers.

Wis., Oconomowoc—E. O. Otto, Inc., P. O. Box 134—equipment for wood-working shops including, jointer, rip saw, band saw, hollow chisel mortiser, mitre machine, etc.

Wis., Shawano—United Fruit Packing Co., c/o H. Opgenorth, Pres., Sheboygan—woodworking machinery.

Wis., Stevens Point—G. A. Sutherland, 1210 Division St.—one 20 ton press, lathe, power machinery, etc.

Wis., West Allis—O. Klasske, 3919 National Ave.—tinners' machinery.

Mo., Joplin—Joplin Center Cord Tire & Rubber Co., 815 Main St.—rubber mill-tire making jacks and small calender pipe.

Mo., Rockville—The Keystone Products Co.—tools and machinery for soap factory.

Cal., Los Angeles—Swift & Co., 922 East 1st St.—refrigerating machinery and equipment.

Ont., St. Thomas—The Elgin Milk Products Co., E. Giles, Mgr.—new modern equipment for the manufacture of butter, ice cream and pasteurized milk, etc.

Metal Working Shops

MIDDLE ATLANTIC STATES

N. J. Bridgeton—I. Tove Co., 353 Bank St., will build a 1 story, 40x80 ft. foundry. Estimated cost, $12,000. W. P. Cameron, Witherspoon Bldg., Phila., Pa., Engr. Noted Aug. 18.

N. J., Florence—The Florence Pipe Fdry. & Machine Shop has awarded the contract for the construction of a smith shop and storage house. Estimated cost, $25,000.

N. Y., New York—Soan & Moeller, c/o Magnuson & Kleinert, Archts., 52 Vanderbilt Ave., will soon receive bids for the construction of a 2 story, 100x125 ft. garage at 327 East 64th St. Estimated cost $60,000.

The Weekly Price Guide

This Week's Market

Steel warehouse prices and quotations on mill shipments have remained unchanged, in New York, since last week. Cutting under the official Pittsburgh schedule of $1.85, for steel plates, has been rumored, quotations having been made as low as $1.70@$1.75. Reductions in tin plate, blue-annealed and galvanized steel sheets are quoted at the mills. Tin plate is quoted at $4.75, as against $5.25; blue-annealed sheets have been reduced from $3 to $2.75 and the price of galvanized has dropped from $4 to $3.75.

Cleveland reports a drop of 15c. per 100 lb. in cold-finished steel, and a general decrease of ½c. per lb. on old metals. Floor plates are quoted at 2.74c., as against 3c. per lb. The only advance in price is 3¼c. per lb. on solder, making the present price 23½c., as compared with 20¼c. previously.

Chicago prices remain firm, with steel quotations, particularly structural shapes, comparing very closely with those of New York.

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	*$24.50
Northern Basic	†21.52
Southern Ohio No. 2	†22.52
NEW YORK—Tidewater Delivery	
Southern No. 2 (Silicon 2.25 to 2.75)	†30.26
BIRMINGHAM	
No. 2 Foundry	*20.00
PHILADELPHIA	
Eastern Pa., No. 2x, 2.25-2.75 sil	†21.76
Virginia No. 2	†28.74
Basic	†20.26
Grey Forge	†22.26
CHICAGO	
No. 2 Foundry local	*20.00
No. 2 Foundry, Southern, sil 2.25@2.75	†26.66
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	21.96
Basic	19.96
Bessemer	21.96

*F. o. b. furnace. † Delivered.

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York	Cleveland	Chicago
No. 10	2.75	3.53	3.25	3.53
No. 12	2.80	3.58	3.30	3.58
No. 14	2.85	3.63	3.35	3.63
No. 16	2.95	3.73	3.45	3.73
Black				
Nos. 17 and 21.	3.40	4.05	3.80	4.45
Nos. 22 and 24.	3.50	4.10	3.85	4.50
Nos. 25 and 26.	3.55	4.15	3.90	4.55
No. 28	3.65	4.25	4.00	4.65
Galvanized				
Nos. 10 and 11.	3.75	4.25	4.00	4.95
Nos. 12 and 14.	3.85	4.35	4.10	5.05
Nos. 17 and 21.	4.15	4.65	4.40	5.35
Nos. 22 and 24.	4.30	4.80	4.55	5.50
No. 26	4.45	4.95	4.70	5.55
No. 28	4.75	5.25	5.00	5.65

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card of July 7, 1921:

BUTT WELD

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
1 to 3	64½	52	⅜ to 1¼	39½	24½
LAP WELD					
2	56½	44	2	34½	20½
2½ to 6	60½	48	2½ to 4	37½	24½
7 to 12	57½	44	4½ to 6	37½	24½
13 and 14	45	37	7 to 12	35½	22½
15	42½	32			
BUTT WELD, EXTRA STRONG, PLAIN ENDS					
1 to 1½	62½	51	1 to 1½	39½	25½
2 to 3	63½	52			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	54½	43	2	35½	22½
2½ to 4	58½	47	2½ to 4	38½	26½
4½ to 6	57½	46	4½ to 6	37½	25½
7 to 8	53½	40	7 to 8	30½	18½
9 to 12	48½	35	9 to 12	25½	13½

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20–5% off.

WROUGHT PIPE—Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
⅜ to 3 in. steel butt welded	60%	46%	52½%	43½%	62½%	50%
2½ to 6 in. steel lap welded	51%	37%	55½%	40½%	48½%	46%

Malleable fittings. Classes B and C, Banded, from New York stock sell at plus 6%. Cast iron, standard sizes, 15% off.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (heavy)	5.00	6.50	8.25
Spring steel (light)	8.00	6.50	10.50
Coppered Bessemer rods (base)	8.00	8.00	6.03
Hoop steel	3.88	3.29	3.48
Cold rolled strip steel	7.50	8.25	7.25
Floor plates	4.85	2.74	5.23
Cold finished shafting or screw	4.23	3.85	3.85
Cold finished flats, squares	4.73	4.35	4.35
Structural shapes (base)	2.88	2.74	2.88
Soft steel bars (base)	2.78	2.64	2.70
Soft steel bar shapes (base)	2.78	2.64	2.70
Soft steel bands (base)	3.43	.....	.....
Tank plates (base)	2.88	2.92½	2.88
Bar iron (mill 2.50)	2.78	3.52	2.78
Drill rod (from list)	55@60%	55%	50%
Electric welding wire	New York		⅜, 8½c. per lb.

⅛—7.15c.; 5/32 to ¼—6.75c. Swedish iron sells at 18½c. per lb. in Chicago

METALS

Current Prices in Cents Per Pound

	New York	Cleveland	Chicago
Copper, electrolytic (up to carlots), New York			12¾@13
Tin, 5-ton lots, New York			26.00
Lead (up to carlots), St. Louis, 4.35; New York			4.75
Zinc (up to carlots), St. Louis, 4.60; New York			5.00
Aluminum, 98 to 99% ingots, 1-15 ton lots	25.00	25@26	30
Antimony (Chinese), ton spot	5.25	6.00	6.00
Copper sheets, base	20.00	20.75@21	20.00
Copper wire (carlots)	15.50	15.50	14.00
Copper bars (ton lots)	18.50	22.00	18.50
Copper tubing (100-lb. lots)	19.00	23.00	20.00
Brass sheets (100-lb. lots)	15.75	18.00	15.75
Brass tubing (100-lb. lots)	18.50	20.00	18.50
Brass rods (1,000-lb. lots)	13.75	15.50	13.75
Zinc sheets (casks), (8% dis. carlots)	11.00	11.15	15.75
Nickel (ingot and shot), Bayonne, N. J.	41.00	.....	.....
Nickel (electrolytic), Bayonne, N. J.	44.00	.....	.....
Solder (½ and ½), (case lots)	17.75	23.50	17.50
Babbitt metal (best grade)	70.00	35.50	35.00
Babbitt metal (commercial)	30.00	13.50	9.00

—Shop Materials and Supplies

MONEL METAL Base price in cents per pound, f.o.b. Bayonne, N. J.

Shots and blocks	$35.00	Hot rolled rods (base)	42.00
Ingots	38.00	Cold rolled rods (base)	56.00
Sheet bars	40.00	Hot rolled sheets (base)	55.00

Special Nickel and Alloys

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	60
Cold drawn rods, Grade "A" and "C" (base)	72
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods, "D"—low manganese	64
Manganese nickel hot rolled (base) rods "D"—high manganese	67

OLD METALS--Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	9.50	9.00	9.50
Copper, heavy, and wire	9.00	9.00	9.00
Copper, light, and bottoms	7.00	7.00	7.00
Lead, heavy	3.25	3.00	3.00
Lead, tea	2.00	2.00	2.00
Brass, heavy	5.00	5.00	7.25
Brass, light	4.00	3.00	4.25
No. 1 yellow brass turnings	4.50	4.00	4.50
Zinc	2.50	2.00	2.50

TIN PLATES—American Charcoal Plates—Bright

		New York	Cleveland	Chicago
"AAA" Charcoal Melyn Grade:				
IC,	20x28, 112 sheets			
IX,	20x28, 112 sheets			
IXX,	20x28, 56 sheets			
IXXX,	20x28, 56 sheets			
IXXXX,	20x28, 56 sheets			
"A" Charcoal Allaways Grade:				
IC,	20x28, 112 sheets			
IX,	20x28, 112 sheets			
IXX,	20x28, 56 sheets			
IXXX,	20x28, 56 sheets			
IXXXX,	20x28, 56 sheets			
Coke Plates, Bright				
Prime, 20x28 in.:			(Base)	
80-lb,	112 sheets			
90-lb.,	112 sheets			
100-lb.,	112 sheets		6.50	
IC,	112 sheets		6.65	
IX,	112 sheets			
IXX,	56 sheets			
IXXX,	56 sheets			
IXXXX,	56 sheets			
Terne Plate				
Small lots, 8-lb. Coating:				
100-lb.,	14x20	$7.50	5.50	
IC,	14x20	7.75	5.75	
IX,	14x20	8.00	6.00	

SHOP SUPPLIES

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	—50%	50–10–5%	—60%
1⅛ and 1¼x3 in. up to 12 in.	—40%	60–10–10%	—55%
With cold punched sq. nuts			
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)			
Up to 1-in. diameter, with cold punched hex. nuts (plus std. extra of 10%)			
Button head bolts, with hex. nuts		390 base	
Hex. head and hex. nut bolts			
Lag screws, coach screws			
Carriage bolts, all sizes up to 1 in. x 30 in.	—45%	60%	—55%
Bolt ends, with hot pressed nuts			
Tap bolts, hex. heads			
Rivets, 7/16 in. dia. and smaller. *New list*	—50–10%	60–10%	—60–10%
Rivets, tinned	—50–10%	60–10%	—45%
Semi-finished nuts, all sizes	—75%	80%	
Case-hardened nuts			
Washers, wrought iron, ½ in., per 100 lb.	$3.00	$4.50 off	$4.50
Washers, cast iron, ⅜ in. and larger, per 100 lb	4.25	3.75 off	4.50
Washers, round plate, off list per 100 lb.			
Nuts, hot pressed, sq. Off list	2.00	2.25	3.00
Nuts, hot pressed, hex. Off list	2.00	2.25	3.00
Nuts, cold punched, sq. Off list	1.50	2.25	3.00
Nuts, cold punched, hex. Off list	1.50	2.25	3.00
Rivets:			
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb	$4.40		3.68
Cone heads, ditto	4.50		3.78
1⅛ to 1⅞-in. long, all diameters, *EXTRA* per 100 lb			
⅞ in. diameter *EXTRA*			
½ in. diameter *EXTRA*			
1 in. long, and shorter *EXTRA*			
Longer than 5 in *EXTRA*			
Less than 200 lb *EXTRA*			
Countersunk heads *EXTRA*			
Copper rivets	50–10%	40–10%	50%
Copper burs	25–10%	15%	50%

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb	$0.07½@$0.10	$0.12	$0.12
Cotton waste, mixed, per lb	055@.09	.09	.10
Wiping cloths per M., 13½x13½		55.00	55.00
Wiping cloths per M., 13½x20½		65.00	65.00
Sal soda, 100 lbs	2.10	3.00	2.65
Roll sulphur, 2-bbl. lots per 100 lb	2.55	3.25	2.75
Linseed oil, per gal., 5 bbl. lots	.78	.83	.80
Fire clay, Ottawa, per 100 lb	.80	.80	
White lead, dry or in oil	100 lb. kegs.	New York, 12.25	
Red lead, dry	100 lb. kegs.	New York, 12.25	
Red lead, in oil	100 lb. kegs.	New York, 13.75	
Coke, prompt furnace	$2.90@3.00		
Coke, prompt foundry	4.00@4.50		

Pa., Philadelphia—L. M. Davis, 1616 Chancelor St., will receive bids until Sept. 5 for the construction of a 2 and 3 story, 60 x 60 ft. addition to garage, on Chancelor St. Estimated cost, $75,000. R. Priest, 1627 Sansom St., Engr.

Pa., Pittsburgh—The Point Motor Co., 36 Penn Ave., is receiving bids for the construction of a 3 story, 75x110 ft. addition to its garage on Penn Ave and Bell Alley. Estimated cost, between $40,000 and $50,000. J. P. Piper, Archt.

Pa., Pittsburgh—A. J. Schmitz, 237 Collins Ave., is receiving bids for the construction of an 8 story, 60x110 ft. garage and warehouse, on Penn Ave. Estimated cost, $150,000. S. Waller, Nassau St., New York City, Archt.

Pa., York—The Reed Machine Co., 231 North George St., has awarded the contract for the construction of a 2 story, 40x100 ft. machine shop. Estimated cost, $15,000.

MIDDLE WEST STATES

Ill., Chicago—C. H. Eckstrom, Archt., 5 North LaSalle St., is receiving bids for the construction of an 8 story addition to printing plant, at 500-10 North Dearborn St., for W. D. Boyce, 508 North Dearborn St. Estimated cost, $400,000.

O., Cleveland—The Aetna Welding Co., c/o J Haag, 4613 Bway., has awarded the contract for the construction of a 1-story, 40x66 ft. welding shop, on Bway. Estimated cost, $10,000.

O., Cleveland—The Carris-Franklin Sales Co., L. C. Carris, Mgr., 3622 Prospect Ave., is having plans prepared for the construction of a 2 story garage on Prospect Ave. Estimated cost, $100,000. Private plans.

O., Cleveland—E. A. Kilroy, 9407 Ramona Blvd., will build a 1 story, 34x100 ft. steel shop at 13800 Miles Ave. Estimated cost, $15,000. Private plans.

O., Cleveland—J. Kirby, Kirby Bldg. has awarded the contract for the construction of a 5 story, 62 x 130 ft. garage on West 6th St. and Frankfort Ave. Estimated cost, $200,000.

Wis., Edgerton—The Highway Trailer Co., c/o J. W. Menhall, Pres., is having plans prepared for the construction of a 2 story, 60x180 ft. trailer factory. Estimated cost, $55,000. Private plans.

Wis., Elkhart Lake—The Public Service Co., c/o W. A. Burke, secy., is receiving bds for the construction of a 1 story, 60x110 ft. power and machine shop. Estimated cost, $100,000. Private plans.

Wis., Manitowoc—The Manitowoc County has awarded the contract for the construction of a 1 story, 40x92 ft. machine shop. Estimated cost, $40,000.

Wis., Milwaukee—The Rosenberg Elevator Co., 174 Reed St., will soon award the contract for the construction of a 1 and 2 story, 120x220 ft. factory, on Franklin St. M. Tullgren & Sons, 425 East Water St., Archts. and Engrs.

Wis., Oshkosh—The Kaerwer Auto Co. has awarded the contract for the construction of a 2 story, 73 x 97 ft. garage, on Main St. Estimated cost, $40,000. Noted July 7.

Wis., Stevens Point—G. A. Sutherland, 1210 Division St., has awarded the contract for the construction of a 1 story, 55x100 ft. garage, etc., on Main St. Estimated cost, $40,000.

WEST OF THE MISSISSIPPI

Kan., Wichita—The Wichita Visible Pump Co., c/o E. P. Hayes, 701 Gilbert St., plans to build a 2 story factory, for the manufacture of pumps, on Gilbert and Santa Fe Sts. Estimated cost, $50,000. Architect not selected.

Mo., St. Louis—The Eagle Motor Truck Co., c/o J. P. Reis, 6154 Bartmer Ave., has awarded the contract for the construction of a 1 story, 50x150 ft. factory. Estimated cost, $50,000. Noted May 19.

Mo., St. Louis—The Midwest Piping Co., c/o A. G. Stoughton, Pres., 1452 South 2nd St., has awarded the contract for the construction of a 1 story, 40x151 ft. factory, on South 2nd St., Estimated cost $50,000.

Tex., Dallas—E. G. Knight, 3617 Cedar Springs St., has awarded the contract for the construction of a 5 story, 116x153 ft. garage on Masten and Pacific Sts. Estimated cost, $167,000.

WESTERN STATES

Cal., Pasadena—The Pasadena Transfer and Storage Co., 65 South Bway., plans to build a 6 story, 66x250 ft. garage and warehouse, on South Marengo St. Estimated cost, $150,000. Architect not selected.

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CANADA

Ont., Simcoe—The Comet Automobile Co., 156-60 South Water St., plans to build a factory here. Estimated cost, $50,000.

T. H., Pearl Harbor—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., will receive bids until Sept. 21, for the erection of steelwork for a 1 story, 181 x 520 ft. machine shop.

General Manufacturing

NEW ENGLAND STATES

Conn., Hartford—The New England Brewing Co., 513 Windsor Ave., has awarded the contract for the construction of a 3 story, 85 x 200 ft. factory, on Windsor Ave., for the manufacture of food products. Estimated cost, $75,000.

R. I., Providence—Williams & Anderson Co., 33 Broad St., plans to build a factory on the block bounded by Highland Ave., North Main, 3rd and 4th Sts., for the manufacture of emblems. Architect not selected.

MIDDLE ATLANTIC STATES

Md., Baltimore—The Western Maryland Dairy Co., A. B. Gardner, Pres., Linden and Dolphin Sts., is having plans prepared for the construction of a dairy plant, etc. Estimated cost, $260,000 J. E. Sperry, Calvert Bldg., Archt.

N. Y., Albany—The Gibson Snow Drug Co., Bway. and Orange St., has awarded the contract for the construction of a 4 story, 38 x 106 ft. factory. Estimated cost, $160,000.

N. Y., Buffalo—The Duffy Silk Co., 1270 Bway., has had plans prepared for the construction of a 3 story, 60 x 175 ft. silk mi'l. Estimated cost to exceed $50,000. Esenwein & Johnson, Ellicott Sq., Archts.

N. Y., Buffalo—The Danahy Packing Co., 25 Metcalfe St., is having plans prepared for the construction of a 4 story 60x67 ft. cooler building on Metcalfe St. Estimated Cost, $45,000. H. Brown, 28 Glenwood Ave., Archt.

N. Y., Buffalo—The Iroquois Natural Gas Co., Iroquois Bldg., is having plans prepared for the construction of a plant for the manufacture of gas. Estimated cost, $4,000,000. L. Brown, Iroquois Bldg., Engr.

N. Y., Long Island City—R. Hellman, Inc., 501 Steinway Ave., Astoria, is having preliminary plans prepared for the construction of a 100x125 ft. factory at 602 Jackson Ave., for the manufacture of mayonnaise dressing. Estimated cost, $150,000. J. K. Turton Co., Inc., 101 Park Ave., New York City, Archt. and Engr.

N. Y., Syracuse—Onondaga Pottery Co., 1858 West Fayette St., has awarded the contract for the construction of a 1 story, 140 x 700 ft. pottery on Court. St. Rd. Estimated cost, $200,000.

MIDDLE WEST STATES

Ill., Chicago—E. W. Bredemeier & Co., 213 North Morgan St., has awarded the contract for the construction of a 3 story, 125 x 132 ft. printing plant at 314-20 South Honore St. Estimated cost, $250,000. Noted May 26.

Ill., Chicago—The Sewell Clapp Envelope Co., 23 Desplaines St., has awarded the contract for the construction of a 1 and 2 story printing plant on Belmont and Tripp Sts. Estimated cost, $250,000. Noted March 17.

Wis., Milwaukee — The Red Star Yeast Co., 79 Buffalo St., is having plans prepared for the construction of a 1 story, 50 x 100 ft. addition to its vinegar plant. Estimated cost, $15,000. E. R. Liebert, 432 Bway., Archt. and Engr.

WEST OF THE MISSISSIPPI

Mo., Monett—E. L. Jerome plans to remodel ice cream plant on Bway. Estimated cost, $5,000. Private plans.

WESTERN STATES

Cal., Los Angeles — H. Guyot, 2300 3d Ave., has awarded the contract for the construction of a 2 story, 72 x 100 ft. factory for the manufacture of furniture, at 740 Clanton St. Estimated cost, $20,000.

CANADA

Ont., Tillsonburg — R. Myrick has purchased a factory and plans to remodel and equip same for the manufacture of butter.